MORE RADIO RECEIVER — Chance or Choice

by

Rainer Lichte

Information please

When viewed in a more generalized way, the entire RF spectrum from 10 kHz to 30 MHz (or extended to around 1500 MHz) can be considered to be the largest source of information available to the public. Access is very easy. In comparison with the almost equally, potent computer networks, the cost is almost negligible. No special knowledge is needed; just get yourself a shortwave receiver and listen in.

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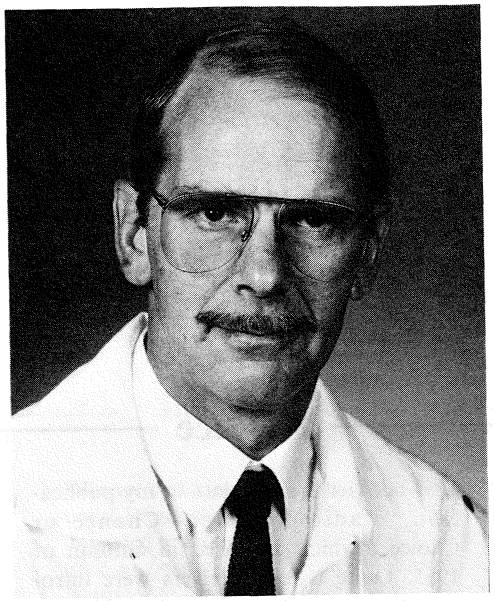
Preface

This booklet is an update to my publication "Radio Receiver – Chance or Choice," which appeared in autumn of 1985. Quite a few receivers were introduced in the following year, so the publisher felt the need to keep the readers informed on these new arrivals. The equipment covered was tested with the same laboratory setup, all values can be compared directly. I've also included several radios which are not real shortwave radios. These communications type receivers have gained considerable interest lately.

Rainer Lichte



About the Author

Rainer Lichte, born in 1944, has twenty years' experience in the field of military electronics. After basic technical education he spent several years as a systems specialist, attended an American university from 1973 to 1976 and later taught at a US Navy electronics school. Since returning to Germany in 1977 he has been technical editor of the German magazine "weltweit hören" (Worldwide Listening). Seven years of living abroad with rare local access to German and European news led him almost compulsively to investigate the technical aspects of short wave reception.

In his leisure time Rainer reads technical literature, repairs and restores old receivers, and plays chess. Married since 1967, he has two children, 14 and 16. He has published many technical articles in Germany and abroad.

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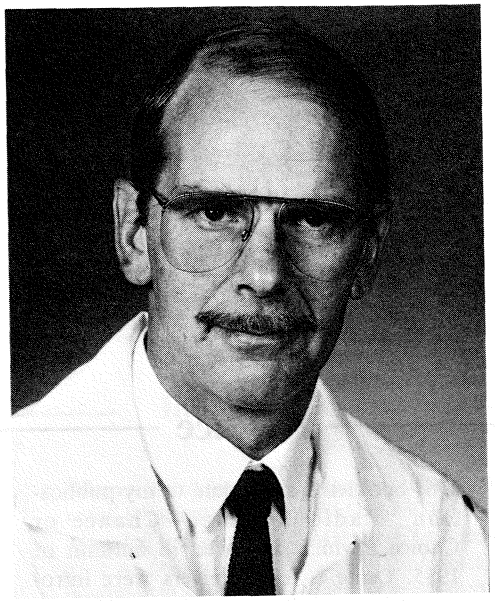

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Past, Present, and Future

Opinions, Facts, and Suggestions

Each year brings a batch of new, shiny receivers. Don't get overly excited by the multitude of knobs, buttons, and switches. The new toy may look very impressive, very professional, but is this brand new receiver actually better than the one you already own? For some of the best catches I've made on the air I've used a simple, old fashioned receiver. Yes, one of those fine portables with good-sized controls, proven circuitry and an analog frequency readout. The reason? I've been working with this particular receiver for years. As a matter of fact, in 1987 this 20-year-old set (BRAUN T1000) is still a dependable workhorse. Some of us tend to forget certain facts about the business of making, selling, and buying shortwave receivers. Here are some interesting facts:

- New receivers are introduced whenever new styles and trends are recognized by just one manufacturer. The other companies have to follow with their own "new" designs.
- The actual electronic circuits remain unchanged for a decade or so. The addition of more features or substitution of new components for older parts not necessarily improves performance.
- Often new components are substituted because they are cheaper than the old parts, e.g. LCD vs. string and pulley arrangements to indicate frequency.
- The new μP controlled receivers can be manufactured faster, cheaper and without tedious and costly manual alignment.
- The manufacturer is not trying to be charitable. The goal is to make money, the more the better.

Most receivers with prices under US$ 300.- are cheap "me too" copies or badly disguised repetitions of existing designs. They perform adequately under normal conditions. The following should be considered when an inexpensive shortwave receiver is desired:

- Presently we are at the bottom of the 11.5 year sunspot cycle. Propagation conditions are bad and unstable, especially for frequencies above 12 MHz. With the increase of sunspots, reception conditions will improve dramatically and the signal density (number of stations receivable within a given segment of the spectrum) will also go up. Most cheap receivers will not be able to cope with this situation, they overload easily and performance suffers. It may be quite sound to invest a few more dollars now.
- Whatever you may read or hear about shortwave activities, – consider the source. The new media (cable TV, video, computer networks, digital radio, satellite communications) constitute no danger to the field of shortwave communication. The number of SW transmitting stations increases steadily, and will continue to do so for at least another 50 years. Why? Shortwave transmissions are a method of political agitation and propaganda. Most of the transmissions were directed at the poor (underprivileged) peoples of the world. The majority of broadcasts is definitely not intended for the few affluent hobbyists in the western hemisphere. Over the years, some of the monies pumped into those "poor" countries was spent on building SW facilities. Now these countries broadcast their point of view to the world at large. Listen in, it's quite interesting.

The few commercial stations count less than .1% of the total number of transmitting agencies.

- The sheer amount of information accessible with a relatively primitive and inexpensive shortwave receiver is simply overwhelming. Computer networks and interactive wide band video communication circuits are costly, they can not reach everywhere and they can be accessed by only a relatively small number of users. At the present state of the art, these networks are not what they seem to be. The access is limited, the obtainable information is limited and there is no privacy. The total cost can be prohibitive.

A shortwave receiver is a one-way device. With some additional hardware you can learn a lot about the world around you, without running the risk of being overheard or watched by "Big Brother". Give this particular aspect some thought.

- Several direct radio communication satellites were proposed as far back as 1976. The necessary hardware (satellites, antennas, receivers) was never built, only prototypes were shown. Anyway, this will be a very costly method to receive broadcasts. On the other hand, manufacturers of SW transmitters have orders totalling more than 5 billion (!) dollars for just the next five years.

By 1990 the actual usage of SW frequencies will have increased by about 30%.

- Watch the outcome of WARC-HFBC II which will take place in Geneva in March of 1987. This conference is trying to organize the allocation of SW frequencies, with special consideration to location, frequency, and intended audience. A very difficult affair, because demands range from absolutely impossible (5530 hrs./day on more than 400 frequencies) to very modest (5 hrs./day on one frequency only).

Looking back at more than twenty years of experience with the necessary hardware of shortwave reception, I'd like to offer a few suggestions to the manufacturers:

- Be honest. Don't introduce a new receiver just for the sake of being first on the market with a new gimmick.
- The published specifications should be obtained by standard industrial measurement procedures, not tailored to look good on paper.
- Get together and work out an agreement on a standard for computer interfacing.
- Use a synchronous detector for A3A signals (amplitude modulated signals).
- Talk to the people buying your receivers, try to get some feedback.
- Think hard about the tendency to incorporate more and more memories. They are practically useless if their content must be scribbled on paper to become accessible. Use an intelligent display to show memory assignment.
- Use rotary controls for tuning, volume, and RF gain.
- Avoid designs with wide band front-ends.
- Put quality before quantity.

What's to come

The standard for upper class receivers is set by Japan Radio's NRD-525. Performance, workmanship and serviceability are excellent.

A fine example of a middle class receiver is presented by Yaesu's FRG-8800. Sony's ICF-2001D (ICF-2010) is an interesting radio, but some improvements could be made (front-end, FM section, audio).

Small portables are plentiful, good examples are Panasonic RF-B60/L and Sony ICF-7600D (ICF-2002).

The concept of the above mentioned receivers will be copied by other manufacturers for years to come.

The next few years will see a further miniaturization of portables, and the addition of still more eye-catching gimmicks on all receivers. This is unavoidable, and completely unnecessary.

Before 1995 the first affordable upper class receivers with digital signal processing will appear. Possibly, some expensive sets will have a programmable computer and a special display to set parameters. Chances are, that filter characteristics and other important information will be displayed in graphic form. The same display could be used to show the contents of memory and/or part of the frequency spectrum (spectrolyzer).

Hopefully, the synchrophase detector will become a standard in receivers costing more than US$ 300.-.

RF input sections will utilize a tuned filter arrangement or a bank of octave or sub-octave filters.

Frequency display and tuning accuracy will be at least 100 Hz, better receivers will have a display with 10 Hz resolution.

Still more conveniences for the operator will be implemented, not all of them really useful. The home computer is here to stay, so we'll see some "black box receivers" that are operated solely by remote computer control. This could become a worthwhile and interesting development. Of course, success and market acceptance depend on the intelligence of the available software and the amount of interference generated by the computer.

Hopefully, some manufacturer will offer a tuned active antenna, interfaced with the receiver's tuning section. Military and commercial agencies utilize this setup since 1975, there is no reason why a stripped-down version shouldn't become available for the hobbyist at under US$ 500.-.

What is state of the art?

As far as I'm concerned Japan Radio Corporation builds the best receivers for the hobbyist. If you can afford one, buy it. It will last for more than 25 years and still be tops. Sony usually is first with innovative designs and novel circuits, but they have left the top to other manufacturers. Presently, some very fine receivers are available. I do not believe better receivers will be built in the near future. More features: yes; more knobs, buttons, and switches: yes. Better performance? No, I don't think so. The time to invest in a high quality shortwave receiver is now.

My recommendations are (in order of preference):

Fixed station receivers

JRC NRD-525
JRC NRD-515
JRC NRD-505
Drake R4245
Drake R7/A
Kenwood R-5000
Icom IC-R71A
Sony CRF 1 *
Yaesu FRG-8800
Sony CRF-320A *
Icom IC-R70
Sony ICF-6800W (orange version) *
Grundig Satellit international 650 *
* these sets can be operated with batteries

Portables or travel radios

Panasonic RF-B60/L
Sony ICF-2001D (ICF-2010)
Sony ICF-7600D (ICF-2002)
Toshiba RP-F11/L
Grundig Satellit international 400
Uniden CR-2021

Light faceprint indicate that receivers are out of production, and would need to be obtained on the used market.

ABBREVIATIONS

A long distance radio listener is called a DXer, from amateur radio usage for distant reception. SWL is a shortwave listener and BCL a broadcast listener. Usually SWLs and BCLs are more interested in program contents and less in reception of very distant stations than DXers, but the boundaries are indistinct. Amateur radio listening and utilities are additional special fields.

The QSL card is a verification of a reception report. This term comes from ham Q-codes that are used to abbreviate frequently used technical terms and are internationally understood among radio amateurs.

Broadcast transmitters for short, medium and long waves use amplitude modulation (AM), while very high frequency (VHF or UHF) stations use frequency modulation (FM). These terms designate the process of transferring voice and music onto the transmitted frequency. Your receiver uses the opposite process, namely demodulation.

Amateur radio and commercial radio services generally use single sideband transmission (SSB). Signals may be sent out on the upper sideband (USB), the lower sideband (LSB), or even using the independent sideband mode (ISB). Hams have an international agreement to use LSB below 10 MHz and USB above that, which simplifies tuning considerably. Certain AM distortions may be reduced by using a good quality receiver in SSB mode. This technique is called ECSS, exalted carrier selectable sideband.

Morse transmissions may use sound or simply turn the RF carrier on and off in the rhythm of the Morse code; the abbreviation CW stands for continuous wave. Many other modulation forms are possible; radio teletype (RTTY) for example employs two alternating frequencies.

Standard S-Meter Readings on Shortwave

Value	μV into 50 Ohms
1	.2
2	.4
3	.8
4	1.6
5	3.2
6	6.3
7	12.6
8	25
9	50
9 + 10dB	160
9 + 20dB	500
9 + 30dB	1,600
9 + 40dB	5,000
9 + 50dB	16,000
9 + 60dB	50,000

S9 is equal to a steady signal input of −73 dBm

Our measurements

Reading accuracy:
Settability of a desired frequency or determination of a station's frequency using analog dials or numerical readouts. Values given are always for the shortwave range(s). A resolution of ± 1 kHz is the required standard, ± 100 Hz is even better, ± 10 Hz is excellent.

Absolute accuracy:
A comparison of the built in references oscillator for PLL-type circuits, or the reference of the frequency counter with a frequency standard. Good receivers should have errors smaller than ± 50 Hz.

Frequency stability:
Deviation from a desired frequency within 30 minutes after turn-on. Measured at room temperature of 21° Centigrade (70° Fahrenheit). Anything below ± 200 Hz is inadequate.

Sensitivity:
In μV/m for frequencies up to 1.5 MHz a S + N/N ratio of 26 dB on sets having only a ferrite antenna for this range. A calibrated loop radiator is used in fully shielded environment. In μV for frequencies as above and a S + N/N ratio of 26 dB on sets with a direct antenna input.

In μV for frequencies above 1.5 MHz and a S + N/N ratio of 10 dB. Standard impedance is 50 Ohms. The test-signal is modulated with an audio signal of 400 Hz at 30%.

An antenna simulator (standard test fixture) is used between signal generator and receiver input.

A receiver is very sensitive if the values given are consistently below 1 μV. Anything up to 3.5 μV is acceptable, thereafter the decreased sensitivity may become quite noticeable.

Bandwidth:
Seletivity measured with 2-signal-method, results are evaluated on spectrum-analyzer. Values are ± kHz.

The ideal configuration is 2 kHz/4 kHz, 3 kHz/6 kHz, and 4 kHz/10 kHz for narrow, standard, and wide, respectively.

Image rejection:
Susceptibility to mirror images of any kind. 2-signal-method of DIN-standard 45300.

Excellent: 75 dB and more; Good: 60 dB to 74 dB; Acceptable: 45 dB to 59 dB.

AGC range:
The ratio of the input signal variation possible to effect a change of ± 3 dB in the audio output. Best conditions are chosen, e.g. AGC off and manual gain control at best setting. A good receiver should have a range of more than 75 dB.

Intercept point 3rd order (ICP 3rd):
Describes the capability of the receiver's front end to handle large signal inputs. Spectrum-analyzer method, frequency spacing adjusted according to filter characteristics of 1. mixer, typically 25 kHz.

+ 15 dBm and above: excellent

+ 5 dBm to + 14 dBm: very good

− 10 dBm to + 4 dBm: good

− 30 dBm to − 11 dBm: acceptable

− 31 dBm and below: unsatisfactory

Tuning indicator:
S1 = smallest readable indication

midscale = geometric centre of scale

end of scale = last pointer movement before signal compression.

Standards: S1: 0.2 μV; S9: 50 μV; end of scale: at least 1 mV.

Audio power output:
Sine wave of 1 kHz fed directly to audio amplifier at hot terminal of volume control or via audio input jack. Tolerance is 10% THD. An audio output of 1 Watt/10% THD is adequate for most surroundings. The real professional uses headphones, anyway.

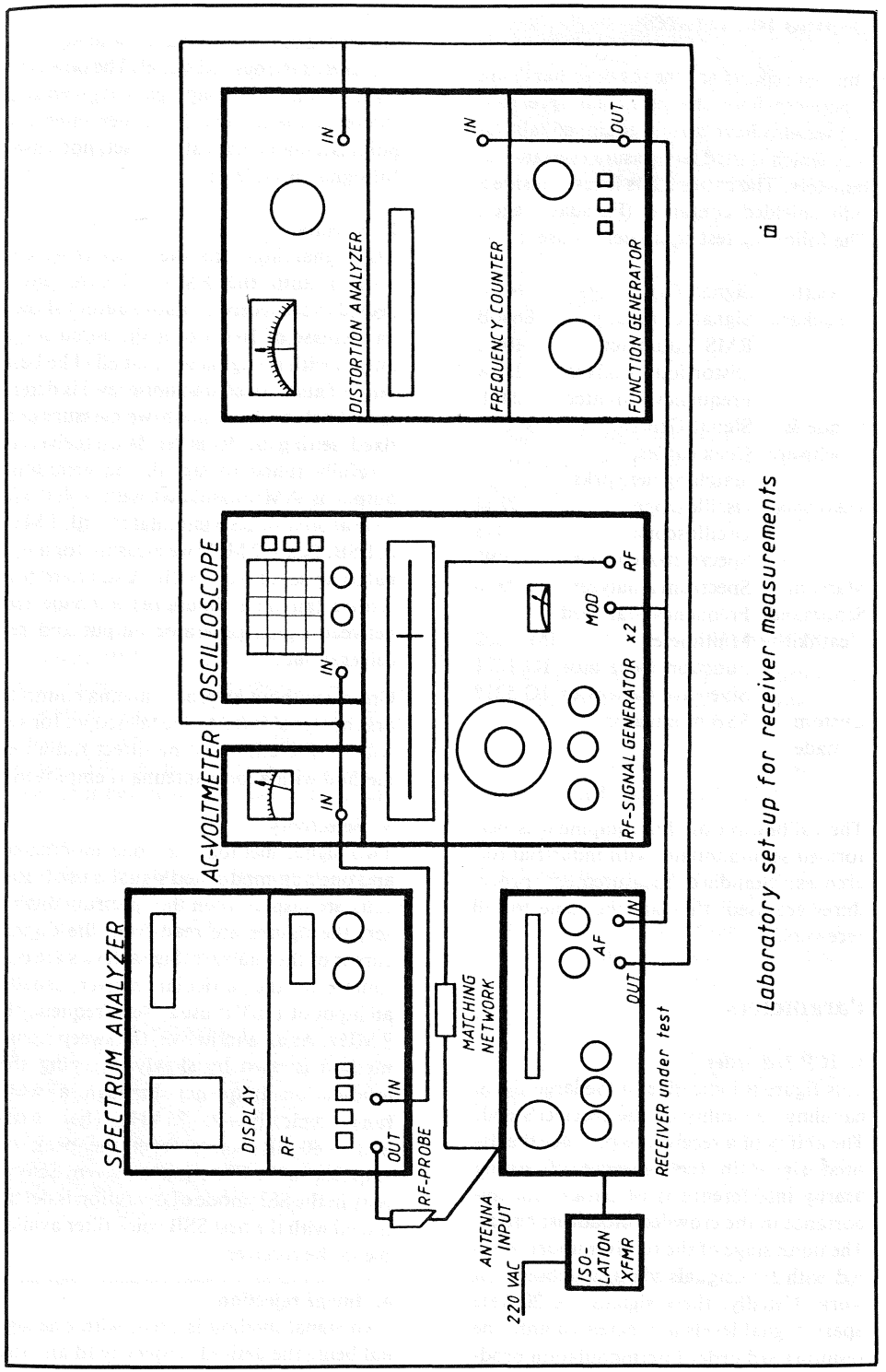
Tone controls:
Effective variation of a 1 kHz signal when

only a single tone control is used, or 1 kHz/6 kHz tones when dual controls (bass and treble) are present. A range of ±6 dB is considered adequate, ±8 dB is better.

Power consumption:
Product of measured current at power supply input and the existing voltage at this point. The battery case is considered a power supply. Volume is set at 50 mW output to speaker.

Weight:
Complete with batteries if applicable. All sets weighed as delivered, including installed options.

The entire laboratory is located inside a shielded enclosure (Faraday cage). All cables and connectors are commercial RG/58U or equivalent with BNC connectors or suitable adaptors for SO-239. Our calibration is traceable to official primary standards and references. The methods of measurements are standard industrial procedures. They have been the same since 1974; with an occasional update of test equipment, of course.



Laboratory set-up for receiver measurements

Behind the figures

Our test reports are the result of hands-on experience with the particular receivers, but we also have a fully equipped laboratory which is used to measure relevant parameters. The entire lab is located inside a fully shielded container (Faraday Cage). The following test equipment is used:

Hewlett-Packard	Signal Generators	606B
	Signal Generator	8640B
	RMS Voltmeter	3400A
	Distortion Analyzer	333A
	Frequency Counter	5245L
Rohde & Schwarz	Signal Generators	SMAF
	Coax cables, matching networks	
Tektronix	Oscilloscope	7844
	Oscilloscope	475
	Spectrum Analyzer	492
Marconi	Spectrum Analyzer	TF 2370
Schomandl	Frequency Standard	
Heathkit	Multimeter	IM 2202
	Function Generator	IG 1271
	Sinewave Generator	IG 5218
Custom made	SSB modulator	

The calibration of this equipment is performed semi-annually with industrial references. Standard measurement procedures are used; they are the same for all receivers.

Parameters

1. ICP 3rd order
This figure is indicative of the large signal handling capability of the receiver's end. The ability of a receiver to produce the desired signal in the presence of strong nearby interference is of paramount importance in the crowded broadcast bands. The input stage of the receiver under test is fed with two signals via a matching network. Usually, these signals are 20 kHz apart. Signal levels are increased until the resulting 3rd order intermodulation products at the mixer output are about equal to the level of the desired signal. The power to reach this level is computed and given as a figure of merit. The 3rd order intercept point is a mathematical abstract, not a useful signal input level.

2. Sensitivity
The signal input to the receiver is decreased until the RMS-Voltmeter connected to the receiver's audio output shows an increase of 10 dB over the audio stage output with no signal input at all. The best ratio of audio output to noise level is determined before, but usually we measure at a fixed setting of 50 mW. The receiver is carefully tuned to signal, the generator output is AM modulated with a 400 Hz tone at 30% or SSB modulated with 1 kHz in LSB. Below 2 MHz we measure for a signal to noise ratio of 26 dB. A standard test fixture (antenna simulator) is connected between signal generator output and receiver input.

On sets without external antenna connectors the signal is fed to the telescope, for set with ferrite antennas the direct radiation method with a loop antenna is employed.

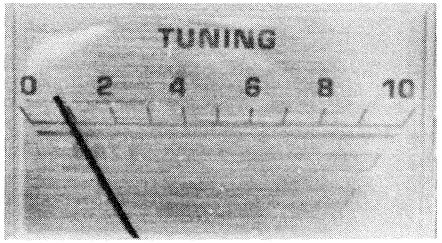
3. Selectivity
Two signal method with one modulated and one non-modulated signal is used. Results are displayed on the spectrum analyzer, the figures are read from the digital cursor of the analyzer. Signal levels are optimized for the particular receiver, usually an input of 1 mV is used. Test frequency is 7 MHz. As an alternative, the sweep signal method is used by slowly sweeping the modulation frequency through a wide range, typically +/−25 kHz. The −6 dB and −60 dB points from the peak of response in the IF output are given. Selectivity in the SSB mode of operation is determined with the best SSB voice filter available in the receiver.

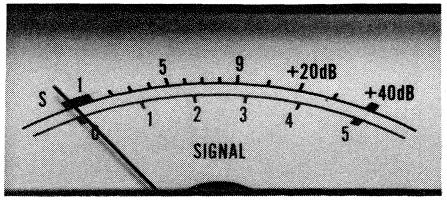
4. Image rejection
Two signal method is used, with one signal being the desired frequency fd and the other signal set to fd +/−2xIF, simulating a station at the image points. The generator output for the image frequency is increased until the image appears at a power level of 38 dB below the level of fd. Test frequency is 7 MHz, fd is kept around 500 uV.

5. Stability
A very stable test frequency at 10 MHz is used. The receiver is tuned to this frequency immediately after turn-on, the necessary amount of retuning after one hour is noted. The room is kept at 21 degrees centigrade. With high quality sets, an indirect method is used by supplying an SSB test signal at 10 MHz, modulated with exactly 1 kHz. The audio output is fed to a frequency counter and the deviation from the original 1 kHz setting after one hour is noted.

6. Absolute accuracy
This measurement is performed only on sets with PLL circuitry. The frequency of the reference oscillator is measured and the deviation from the frequency for which this particular quartz crystal was cut is noted. The set is allowed to stabilize for one hour before measurements ae taken.

7. AGC
The dynamic range of the automatic gain control circuit is measured by supplying a standard test signal (7 MHz, 30% modulated with 400 Hz) at around 1 mV to the





receiver. The RMS-Voltmeter at the receiver's output is to set to a relative 0 dB. Then the signal generator level is increased and decreased for a +/−6 dB reading on the meter. The difference in signal generator level between these points is given in dB.

8. Signal strength indicator
A true S-meter should read S9 with a signal input of 50 uV into 50 ohms. We use a standard test signal to determine

a) indicator reaching the first mark on the scale
b) mid-scale
c) end of scale without compression.

Compression occurs, when a further increase of signal input will not show on the meter.

On sets with just a single LED we note when this LED comes on brightly.

9. Audio section
The frequency response of the audio amplifier is measured at either the "hot" end of the volume control or the power amplifier output. The loudspeaker (if built in) is not part of this measurement.

Power is measured at 10% total harmonic distortion (THD) across a resistive load of either 4 ohms or 8 ohms at the speaker terminal.

Tone controls are referenced to 1 kHz if only a signal control is provided, to 400 Hz and 3 kHz if separate controls for bass and treble are available.

Conversion Factors

1 kilometer (km)	=	1 000 meters (m)
1 meter (m)	=	100 centimeters (cm)
1 centimeter (cm)	=	10 millimeters (mm)
1 meter	=	1 000 millimeters
1 inch	=	2.540 cm
1 foot	=	30.48 cm
1 mile	=	1.609 km
1 centimeter	=	0.3937 inch
1 meter	=	39.37 inch
1 kilometer	=	0.6241 mile
1 kilogramm (kg)	=	2.2046 pounds
1 pound	=	453.6 gr
1 kilogramm	=	1 000 gramms (gr.)

Receiver Reviews

ESKA RX-33

Manufacturer	ESKA Electronik, Mollestrade 5, DK-3400 Hillerod, Denmark
Type of receiver	portable
Type of circuit	double superheterodyne, PLL synthesizer
Frequency coverage	LW, MW, FM, plus 150 kHz – 30 MHz
Display accuracy	1 kHz
Frequency stability	+/– 95 Hz/hr
Remarks	Modified version of Sangean ATS-803. Has narrow filter on AM, 9 memories, SSB. Good sound, good reception. Clock and timer are built-in. FM stereo reception.

RF-section

		Bandwidth		
	Frequency	wide	narrow	SSB
Sensitivity in µV for 26 dB	.15 MHz	44	31	–
S+N/N below 1.5 MHz	.50 MHz	44	30	–
	1.00 MHz	38	28	–
Sensitivity for in µV for 10 dB	1.50 MHz	38	26	–
S+N/N above 1.5 MHz	2.00 MHz	2.3	2.0	1.2
	3.00 MHz	2.2	1.8	1.2
Modulation 400 Hz at 30%	5.00 MHz	2.2	1.8	1.5
	7.00 MHz	2.0	1.5	1.5
	10.00 MHz	1.8	1.4	1.4
	20.00 MHz	2.0	1.5	1.5
	30.00 MHz	2.2	1.7	1.6

Bandwidth at – 6/ – 60 dB	wide	normal	SSB
in +/– kHz	4.1/11	2.3/5.3	2.3/5.3

Image rejection	58 dB
AGC range	76 dB
ICP 3. order	– 17 dBm
Dynamic range	79 dB
Tuning indicator	S1 3 µV
	end 18 µV
Antennas	telescope 140 cm, ferrite rod
Antenna connectors	one, for all frequency ranges
Remarks	antennas can be switched from internal to external

AF section

Audio power	1.4 watts at 10% THD
Audio frequency range	118 Hz – 8.5 kHz (+/– 3 dB points)
Tone control	+/– 8 dB at 1 kHz
Noise limiter	no
Speaker	3.5", 8 ohms
Connections	earphone, record out

General

Power supply	six D cells, or external 9 VDC at 250 mA
Power consumption	approx. 1.2 VA
Dimensions	31 × 16 × 6.5 WHD in centimeters
Weight	approx. 1.6 kg (3.5 lbs)
Accessories	manual, headphones, carrying strap, frequency list
Price	approx. US$ 250.-

Miscellaneous

FM sensitivity	1.9 µV for 26 dB SINAD
Accuracy of clock	+ 24 seconds/month

ESKA RX-33/Sangean ATS-803

This familiar looking receiver is worldwide available with varying designations. The parent company is Sangean, a large manufacturer in Taiwan. Eska has developed a modified version which is sold as Eska RX-33.

Mixed parenthood

The basic concept of Sony's ICF-2001 (1979 vintage!) is still recognizable. There also is some likeness to Uniden CR-2021, which is more or less a copy of the Sony receiver. Sangean has taken up this lead with some delay, the ATS-803 was born late in 1985. This radio is produced in large quantities, it is advertised under dozens of names and sold with extreme differences in price. Sangean is a very large manufacturer, they make quite a few products which are marketed by well known companies under their own respected name. In the case of this particular receiver, only Eska puts their name on the modified version. All other look-alikes are the original ATS-803. This test report covers the "Eska special". I have checked the performance of the ATS-803, and frankly, I wasn't impressed a bit. It is a run of the mill multiband receiver without any spectacular highlights. The Eska RX-33 is a completely different radio. A close study of the schematic diagrams reveals about 20 circuit modifications. These include a good ceramic filter in the "narrow" position of the added bandwidth selector function.

Good sound, many features

The large LCD is eye catching. Besides frequency and range, several other informations are displayed:

- time, timer operation, shut-off delay
- meter band
- memory allocation
- operator prompts

The radio is switched to "ON" with a light touch on the large pushbutton marked POWER. All ranges must be selected man-

ually with one of the five tiny buttons in the lower center. FM, AM, LW, MW, and SW are available, – a funny combination, or not? I'd say not, because the AM button selects the entire range from 150 kHz to 30 MHz. SW should be read as SW (broadcast bands only): all shortwave bands from 120 m to 11 m can be accessed sequentially with this button. Direct frequency access (in any band) is also possible with the numeric keyboard. Last not least, a large knob can be used for manual tuning. But that isn't all. In addition to all those functions, the logic circuits can do

- memory scanning
- automatic tuning (halt on station)
- step tuning
- memory read/write operations

The above listed functions are controlled by the following buttons:

MODE	changes display from frequency to time and back
STORE	must be pressed before a frequency is written into a designated memory
START/STOP	controls automatic tuning
DOWN/UP	controls step tuning. 1 kHz on AM, 50 kHz on FM

Volume, bass, and treble controls are located in the upper right hand corner. Here another control marked BALANCE gives a clue to this radio's ability to receive FM stereo broadcasts. Thoughtfully, a pair of headphones are included. Two small buttons below control BFO pitch and RF gain. The tiny switches in the bottom right hand corner are used to

- switch AM bandwidth from narrow to wide, or set the mode of reception from mono to stereo on FM
- activate the SSB mode on AM by enabling the BFO control
- lock the controls to prevent any accidental power "ON" switching

Three more buttons are located on top:

- display illumination (momentarily)
- sleep timer (10 to 90 minutes)
- timer on/off

Audio outputs (DIN and minijack) are located on the left side. The connectors are wired for stereo.

A battery case is accessible on the rear. Six D cells are needed to power the radio, two AA cells provide power for the clock and memory chips. When powered by external DC, 9 volts at about 250 mA are required.

The plastic cabinet is of average quality. Some minor details must be criticized: extremely sharp corners on the bottom, fuzzy lettering, and a next to useless bent wire on the rear which can neither be used as a handle nor serve the function of a stand.

The RX-33 comes complete with headphones, a carrying strap, an operator's manual, and a hefty frequency list. In some countries, a small outboard power supply is included.

Mixed feelings

The control logic shows the time on the LCD when the radio is set to "OFF". When "ON", the display shows frequency and mode settings for about 30 seconds when no more tuning is done. Thereafter, time is displayed again. Frequency information is not lost, it can be recalled by hitting MODE. But again, after 30 seconds. . . . This is a silly feature and should be changed to permanent frequency display when the set is in operation.

Manual tuning causes an annoying clicking sound in the speaker for every single one of the 25 electronically generated tuning steps. When tuning is done a little bit too fast, the tuning rate on AM is increased dramatically and can cover up to 100 kHz for a single step.

The synthesizer is very slow. Occasionally, a funny effect happens when a new frequency is selected: several other stations are audible for a split second before the oscillator comes to rest at the correct frequency. In addition, the narrow filter causes severe audio distortion when the set is tuned close to or within a strong AM signal. All in all, manual tuning is a hectic affair. I didn't like this feature at all.

Step tuning, on the other hand, is allright; and the automatic (station seeking) tuning works almost to perfection. The radio stops only on "good" signals, with an occasional difference of +/–1 kHz. Corrections are easy, just hit the UP/DOWN button once. On MW (BCB) the automatic tuning steps are either 9 kHz or 10 kHz (selectable by the user).

On SW, the RF/IF section produces a distinct background noise (hiss). It takes rather strong signals to mask this distractive noise entirely. Five LEDs are used for signal strength indication, this display is very optimistic and lights up all the way with input signals of about 20 μV.

Once set to a frequency, the Eska RX-33 performs admirably. Indeed, the modifications are noticeable. Above all, a near perfect balance between selectivity and audio quality was achieved. There are very few mirror images and only occasionally an internally generated spurious signal comes through. The measured values for sensitivity are average, the previously mentioned hiss is not caused by a "hot" circuit but indicates the mobilization of all circuit reserves. High gain with minimum noise costs money, and this receiver is sold at a very competitive price.

Large RF signals cause the usual problems. If cross- and intermodulations appear, one simply has to reduce the length of the telescope. The RF gain control has a range of only 15 dB and is best suited to improve the quality of SSB signals. The BFO control, on the other hand, has an excessive range and it takes a lot of patience to get clean SSB demodulation. The narrow IF filter can be used throughout the entire range from 150 kHz to 30 MHz. This makes limited BCB DX possible, but an external aerial is necessary because of the set's average sensitivity. External antennas cause no problems, the number of stations increases significantly with no apparent overloading effects. The external/internal antenna selector switch on the back is operative only when the plug is inserted into the minijack which is the input for external aerials. The standard miniplug is larger than the clearance provided by the wire stand, so some caution is advised when the set is laid on its back.

FM reception is good, the amount of increase in background noise when the circuit is switched to "STEREO" is about normal. The audio quality of this radio is above average on all bands and under all conditions.

Summary

The modified Sangean ATS-803, a.k.a. Eska RX-33 is decidedly better than any standard version of this receiver. Except for certain handling problems, overall reception qualities are commendable. Audio is excellent, only the Grundig Satellit 400 performs better in this class.

The availability of only nine memories could be a disadvantage when the radio is used regularly to monitor a large number of broadcast stations; an application for which this receiver is ideally suited. Automatic tuning and step tuning are almost faultless, manual tuning is simply disastrous.

External antennas can be used with good results. A matchbox is recommended. At average volume levels, about 100 mA of current are drawn from the batteries. This could yield 50 to 60 hours of intermittent operation from a single set of alkaline batteries.

Eska's RX-33 is a serious little multi-band receiver with above average performance in this class. The difference to the standard version, i.e. Sangean ATS-803, justifies the increase in price.

ESKA RX 99PL

Manufacturer	ESKA Electronik, Mollestrade 5, DK-3400 Hillerod, Denmark
Type of receiver	communications type, portable/stationary
Type of circuit	double superheterodyne, PLL synthesizer
Frequency coverage	30 kHz – 30 MHz, plus standard FM-range
Display accuracy	10 Hz
Frequency stability	+/– 15 Hz/hr
Remarks	Modern design, sturdy construction. Has direct access tuning, direct band access, automatic searching. 99 memories, digital clock. Novel membrane keyboard. Two filters, external antenna input. Can be operated from batteries. Numerous options available, see text.

RF-section

	Frequency	Bandwidth wide	narrow	SSB
Sensitivity for 26 dB S+N/N	.15 MHz	40	33	–
below 2 MHz	.50 MHz	35	28	–
	1.00 MHz	30	23	–
Sensitivity for 10 dB S+N/N	1.50 MHz	30	25	–
above 2 MHz	2.00 MHz	1.3	1.0	.9
	3.00 MHz	1.6	1.2	.9
Modulation 400 Hz at 30%	5.00 MHz	1.2	1.1	.9
	7.00 MHz	1.0	0.8	.6
	10.00 MHz	1.0	0.8	.8
	20.00 MHz	1.0	0.8	.8
	30.00 MHz	1.2	1.0	.9

	wide	normal	narrow
Bandwidth at –6/–60 dB in +/– kHz	–/–	4.4/10.2	2.3/5.1

Image rejection	78 dB
AGC range	84 dB (probably a circuit defect)
ICP 3. order	+6 dBm
Dynamic range	94 dB
Tuning indicator	S1 2 µV; midscale 35 µV; end 1 mV
Antennas	auxiliary telescope 90 cm
Antenna connectors	BNC
Remarks	input attenuator 15 dB; preamplifier 10 dB

AF section

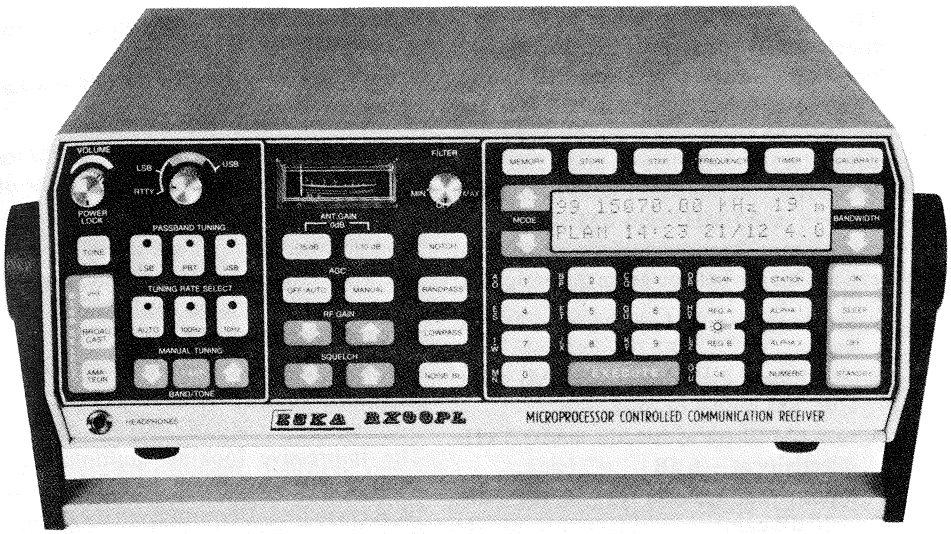
Audio power	1.2 watts at 10% THD
Audio frequency range	160 Hz – 7.1 kHz (+/–3 dB points)
Tone control	4 steps
Noise limiter	optional
Speaker	3", 8 ohms
Connections	external speaker, earphone, record

General

Power supply	six D cells, or Ni-Cad battery with charger
Power consumption	approx. 1.2 VA
Dimensions	25 × 9 × 29 WHD in centimeters
Weight	approx. 2.2 kg (5 lbs)
Accessories	manual, schematics, list of options
Price	approx. US$ 3000.-

Miscellaneous

FM sensitivity	1.4 µV for 20 dB SINAD
FM bandwidth	narrow band FM : 15 kHz (option)
Passband shift	+/– 1.5 kHz
Notch attenuation	single tone : – 24 dB
Spurious signals	62 dB below wanted signal (worst case)
Accuracy of clock	+8 seconds/month



ESKA RX 99PL/M

Only a handful of these receivers have been made and sold. The set is very expensive (approx. US $3000.00) and it takes several months to get one. Is it worth the price and the money?

Most advanced multi purpose receiver?

This is what the manufacturer claims. The story of how this receiver came into being is an adventure of its own, part of it can be read in the 1985 edition of Chance or Choice and the 1986 WRTH.

I met Eddy Visser (the brain behind this concept) in 1983, and we talked about his ideas at length. It took several years until, in autumn of 1985, I could lay hands on a real, fully operational RX 99PL. As a matter of fact, I wasn't impressed at all.

A clear distinction must be made between

- what features are built into this receiver as delivered
- what features must be optionally bought
- how the receiver actually performs.

Another question mark lurks behind some of the options listed: they were simply not available for testing even late in 1986.

So let's start with a description of the concept. The RX 99PL is an unusual receiver, no doubt about that. The multitude of functions and the numerous options (either available or planned) are simply overwhelming. The radio itself is built around a 64k microprocessor which is used to control functions like frequency generation, display, mode and switching logic, memory management, etc. A sturdy black aluminum cabinet houses the entire electronics. The functions are neatly divided into separate circuit boards. When opened up, the inside works look more like one of those terribly expensive signal generators from Hewlett Packard or Tektronix.

The front panel controls are formed by a touch-sensitive membrane keyboard, with only three analog controls remaining. These are used for volume, PBT and notch. The receiver is a double superhet, with a 1st IF of 70 MHz (!) and a 2nd IF of 10.7 MHz. The standard RX 99PL covers 30 kHz to 30 MHz and FM. Other frequency ranges are available as an optional extra. This is what you get in the basic unit:

- synchrophase AM detector with PLL lock
- AM, phase locked AM (PLAM), SSB, CW, FM modes of operation
- two AM filters with 4 kHz and 2.2 kHz selectivity at −6 dB
- input circuit settable to −10 dB, 0 dB, +10 dB gain
- 99 memories for frequency, mode, and filter
- direct access tuning, step tuning, scan, search
- digital clock and sleep timer
- calibration circuit for +/−10 Hz accuracy
- 4 step tone control low/medium/high/music

Numerous options are (or will be) available at extra cost. The following list may not be complete, and does not imply availability except where marked with an asterik (*):

* narrow band FM detector
* alpha-numeric indication of owner programmed station name
* multi-channel timer (24 slots) with switching output
* audio notch filter, 200 Hz to 6 kHz in 3 ranges
* nine different filters with values between 500 Hz and 15 kHz, up to three extra filters can be installed
* additional memory board with 99 channels
* Ni-Cad battery and charger
- external speaker
- frequency converters 60-88 MHz, 140-170 MHz, 30-500 MHz
- active antenna 10 kHz to 30 MHz
- mobile mounting bracket
- interface for remote control via modem
- noise blanker
- outboard VFO for analog-like manual tuning

A general purpose computer interface board is required in addition to most of these options.

Several other versions are available. The RX 99M is tailored for marine applications. Another version conforms to military specifications (MILSPEC).

Operation and performance

The impressive looking multi-coloured front panel is scattered with 58 control surfaces (switches). Depending on the disposition of the owner/operator, this keyboard is a joy or a nuisance. From a purely subjective viewpoint (the author's), the operational concept of this receiver is an ergonomic disaster. The keyboard is not illuminated, the touch areas are rather small, and there is almost no tactile feedback. In addition, the often used rotary controls are way to small and inconveniently placed. Manual tuning can be performed in steps of 5 kHz (SW bands), 10 (9) kHz (LW, MW), and 1 kHz outside the broadcast bands. A fast tuning function increases these rates by a factor of 6. In addition, fine tuning with steps of either 10 Hz or 100 Hz is selectable.

Apart from the gruesome handling, the receiver itself performs admirably. There are numerous signal processing circuits which can be employed to improve signal quality and/or combat interference of any kind. The ESKA RX 99PL is the only receiver with a combination of all the niceties which are desired by the serious listener, e.g. PBT, PLAM, ECSS, wide choice of filters, intelligent display, memories, etc. The passband tuning (PBT) tunes from the top edge of one sideband straight through to the lower edge of the other sideband (SSB only).

The synchronous AM detector works with either sideband (or part of a sideband) of the dual sideband signal transmitted by radio stations. But, Eska's PLAM circuit does not work any better than the (cheaper) concepts used in e.g. the NRD-525 or ICF-2010. Severe fading conditions can not be handled by either circuit, once carrier lock is lost, new synchronizing must take place. This produces an audible (and annoying) noise.

The set tested had the notch filter installed. This circuit is not the perfect solution one would expect. Notch depth was measured at −24 dB, a far cry from the −30 dB measured in the NRD-525.

The filters are excellent, industrial standard at its best. Optional filters are rather expensive, though. As long as the set is tuned to one frequency everything is fine. All parameters can be adjusted to improve signal quality. The shielding enclosure prevents any direct-radiation problems. Internally, additional shielding is used between the digital section and the RF section.

Problems appear when dynamic operation is required, e.g. searching through a certain range, checking a frequency here, monitoring a signal there. Then you begin to hate the awkward membrane keyboard. In addition, the lousy signal strength indicator (a cheap 50¢ item) is almost useless. It is driven by the AGC which in turn isn't flawless either. The mode logic/μP section is not entirely foolproof. When hitting several buttons in sequence or simultaneously, the μP will get mixed up and display either the default frequency of 10 MHz or clamp up altogether. This can produce interesting readings on the dot-matrix LCD. Incidentally, the version tested had an improved display which could be read under most lighting conditions.

The microprocessor has been programmed to give direct access to SW bands and ham bands. In addition, sophisticated scanning and searching functions are available.

The display indicates most mode settings, and also the time, meter band, memory channel and—when the optional alpha-numeric board is used—even the name of the station. This, of course, must be entered by the user, there is no automatic function to do this.

Laboratory measurements of the synthesizer and the RF/IF section yielded interesting values:

- the synthesizer is rather quiet (94 dBc)
- the AGC is simply mediocre (range is less than 90 dB)
- dynamic range is good (but not outstanding)
- ICP 3rd order is very good (for a portable).

For details see Technical Data and Measurements.

Collectors item

The RX 99PL can not be recommended for either shortwave listeners or serious DXers. This receiver is ideally suited for monitoring or doing RTTY, FAX, or SSTV signal processing via outboard converters. The ergonomics leave a lot to be desired, while the level of workmanship and construction is not even close to what other manufacturers offer in this price range.

The RX 99PL could make an ideal travel companion, it weighs about 2.5 kg (5.5 lbs) and runs for about 15 hours on its self-contained Ni-Cad battery. But, the receiver can not be operated in the dark, though the LCD is backlit on demand. The highly touted PLAM circuit does not perform significantly better than that of the much cheaper Sony ICF-2010. Service and availability of options (when needed) could become a nightmare.

On the other hand, there is no receiver available anywhere and at any price, with all those specialized functions. If you do not need these functions or options, a Sony CRF-1 for travelling and a JRC NRD-525 in your shack may do nicely,—at half the cost of this exotic receiver from Denmark.

Grundig Satellit International 400

Manufacturer	Grundig AG, Kurgartenstrasse 37 D-8510 Fuerth/Bayern
Type of receiver	medium sized portable
Type of circuit	double superheterodyne, PLL synthesizer
Frequency coverage	LW, MW, FM, SW 1612 kHz – 30 MHz
Display accuracy	1 kHz
Frequency stability	+/–35 Hz/hr
Remarks	Excellent portable with above average performance. 24 memories, numerous features. Has clock and dual timer function. Mains supply is built-in. Very good sound.

RF-section

	Frequency	Bandwidth wide	narrow	SSB
Sensitivity in µV for 26 dB	.15 MHz	31	–	–
S+N/N below 1.5 MHz	1.00 MHz	32	–	–
Sensitivity in µV for 10 dB	1.50 MHz	26	–	–
S+N/N above 1.5 MHz	2.00 MHz	1.7	–	1.4
	3.00 MHz	1.6	–	1.2
Modulation 400 Hz at 30%	5.00 MHz	1.5	–	1.2
	7.00 MHz	1.5	–	1.1
	10.00 MHz	1.4	–	1.0
	20.00 MHz	1.5	–	0.9
	30.00 MHz	1.5	–	1.1

Bandwidth at –6/–60 dB	wide	normal	narrow
in +/–kHz	–	2.3/5.5	–

Image rejection	59 dB
AGC range	86 dB
ICP 3. order	–13 dBm
Dynamic range	82 dB
Tuning indicator	S1 3 µV midscale 42 µV end 76 mV
Antennas	telescope 115 cm, ferrite rod
Antenna connectors	one coax socket for all frequency ranges
Remarks	insertion of plug into socket disables internal antennas. 15 dB attenuator for external antenna inputs

AF section

Audio power	3.2 watts at 10% THD
Audio frequency range	68 Hz – 10.8 kHz (+/–3 dB points)
Tone control	+/–9 dB at 1 kHz
Noise limiter	yes
Speaker	3.5", 8 ohms
Connections	earphone, record out, control for Grundig cassette recorders with special cable

General

Power supply	110/220 VAC, or six C cells, or external 12 VDC
Power consumption	approx. 1.4 VA minimum
Dimensions	32 × 18 × 7 WHD in centimeters
Weight	approx. 2.5 kg (5.5 lbs)
Accessories	manual, frequency list
Price	approx. US$ 400

Miscellaneous

FM sensitivity	1.5 µV for 26 dB SINAD
Spurious signals	63 dB below wanted signal
Accuracy of clock	+/–11 seconds/month

Grundig Satellit 400

No, this is not the Satellit 300. Grundig put completely new electronics in a familiar package. The new Satellit 400 is not what you'd call a cheap portable. As a matter of fact, this radio is downright expensive.

More than a pretty face

The clean and unassuming looking front panel shows relatively few control elements. Notwithstanding, there are numerous functions. This radio is a modern development with full microprocessor control, synthesized frequency generation, and exceptional conveniences. Several methods can be used to select a desired frequency:

- SCAN recalls programmed memory channels in automatic sequence, working its way either up or down from a given starting point (channel). Holding time is about 3 seconds.
- STATION recalls one of 24 memories
- SEARCH starts an automatic tuning process in either direction from a starting frequency on LW, MW, and FM.

On SW, certain pre-programmed spot frequencies are called. In addition, any broadcast or ham band can be accessed directly by entering the meter band and hitting FREQ/m BAND once. Again, the tuning logic recalls certain factory preset frequencies. Usually these are the lower limit of the respective band.

Direct keypad access to frequencies is also possible. Just enter the numbers and hit FREQ/m BAND. The correct range (FM, SW, LW, MW) must be set separately.

Last not least, a large rotary control on the right hand side of the cabinet is provided for manual tuning. There are no moving parts (except for the knob itself), tuning is completely electronic by stepping in increments or decrements of either 1 kHz (all AM ranges) or 10 kHz (on FM). A varying multiplication factor is introduced when the knob is rotated very fast. The audio output is muted during any of the tuning functions listed above.

The large LCD shows

- frequency (1 kHz resolution on SW)
- time 1, time 2 (e.g. local time and UTC)
- timer 1, timer 2 ("ON" time only)
- frequency range, i.e. LW, MW, SW, FM
- m band (meter band)
- memory channel (1 to 24)
- AUX (playback from external audio source)
- AS = automatic search in process
- CH = check phase during audio muting
- HA = manual tuning is selected
- FREE = unused memories
- FULL = all memories allocated
- ERROR = input error

Numerous other functions are accessible when certain input combinations are used. A number input followed by FREE will erase the specified memory location. STORE will do just the opposite, i.e. write the frequency into the designated memory. There's a lot more, above all a clever method to set time and/or program the timer(s). The operator's manual explains all in great detail.

New name, new electronic circuits

Besides the new name and a different colour scheme, Grundig engineers also designed completely new electronics for this new portable radio. SSB reception is possible with a beat frequency oscillator. An attenuator switch is provided for strong SW signals from external antennas. The coax input is on the back, here antennas for all frequency ranges may be connected. A switch is activated when the correct plug is inserted. This switch disables all internal antennas (telescope and ferrite rod).

A mains power supply is built right into the cabinet, the input voltage can be set to either 110 VAC or 220 VAC. The radio also runs on external voltages (10 to 15 VDC at approx. 400 mA) or on its own set of six C size batteries. In addition, three AA cells are required at all times to keep the clock circuit and the memory alive. As long as mains power is provided, the LCD remains dimly lit, even when the radio is switched to "OFF". In this state, either TIME 1 or TIME 2 is shown on the display

The large LCD can be illuminated momentarily. Simultaneously, a battery check is performed. The results are shown on a special scale in the lower part of the signal strength indicator.

Audio inputs and outputs are on the left hand side of the cabinet. The special 7 pin DIN socket is wired to switch certain Grundig cassette recorders automatically with the radio's timer. A special cable (STK 227) must be used. The timer can be programmed to operate twice within 24 hours. Only the "ON" time can be programmed, once activated the timer runs for 59 minutes.

The large signal strength indicator has a non-standard scale marked from 1 to 10. A folding carrying handle and a foldout stand are integral parts of the sturdy cabinet. The long telescope antenna can be retracted completely and stores inside the cabinet.

New design, new tricks

A new approach to receiver design is visible in the schematic diagrams. The shortwave range covers 1.612 MHz to 29.999 MHz, only this range works with the double superhet configuration. Inputs from the antenna are run through two gain controlled RF amplifiers before they are converted to an IF signal in a balanced mixer. 1st IF is 54.5 MHz, 2nd IF is 450 kHz. A monolithic crystal filter is used after the first mixer. The 2nd IF amplifier chain has a ceramic filter with 6 poles. The response of this filter is altered by special circuitry to yield a well balanced, distortion free audio signal. Quite a few portables have better selectivity, but at a price: distorted audio. Ceramic filters with sharp skirt response have a tendency to introduce a certain amount of third order distortion. Grundig chose to flatten the response somewhat to favour better audio quality.

The automatic gain control circuit has an enormous range. Weak signals are received with a minimum of background (circuit) noise. The ability to bring in weak stations is probably the most surprising feature of this new radio. In direct comparison, the Satellit 400 could equal the performance of both Uniden CR-2021 and Sony ICF-2010. It is only SSB reception where this Grundig receiver simply can not compete.

There are separate front ends and IF strips for LW and MW, SW, and FM. In most portables, the same amplifiers are used for all bands, only the IF filters are switched. Here completely separate IF amplification takes place, with appropriate filters (narrow for SW, somewhat wider for LW and MW). The FM circuit also is a completely separate unit. The output from those three sources is processed via the muting circuit and subsequently fed to the audio amplifier. The amount of electronics used to accomplish this concept is simply fantastic.

This elaborate RF/IF section is followed by a powerful audio amplifier which in turn feeds a large speaker. The new Grundig probably is the best sounding portable in this class.

Black beauty

The Satellit 400 is a sensitive receiver. The older Satellit 300 was rather conservative in this respect. This new radio is a true station getter, despite its plain appearance. Selectivity is allright, but I still wonder what this set could do with manual RF gain control and a really sharp filter. As it is, the Satellit 400 is a capable performer on SW with still better qualities on the other ranges.

There are a few spurious signals in regions not occupied by broadcast stations. These birdies can be annoying when you are trying to receive out of band stations or weak ham signals. SSB voice reception is possible, but I would not recommend this receiver if SSB is important. The BFO is somewhat tricky to adjust and the lack of manual gain control produces some distortions when the internal AGC starts to ride gain. Clearly, this Satellit is a SWL device, but in a class of its own. If you need better SSB reception, either Uniden CR-2021 or Sony ICF-2010 should be your choice.

Yes, this radio is expensive, and yes, it is relatively large and heavy. On the other hand, you are rewarded with solid performance, excellent sound, clean styling, and lots of convenient features. The Satellit 400 should be the connoisseur's choice. It may not look as spectacular as Sony ICF-2010, but it has about equal performance on SW – and much better sound. There are very few portables which could match the BCB and FM reception of this new Grundig.

Grundig Satellit 650

Manufacturer	Grundig AG, Fuerth, Bayern, West-Germany
Type of receiver	oversize portable
Type of circuit	double superheterodyne, PLL synthesizer
Frequency coverage	LW, MW, FM, SW 1.6 to 30 MHz
Display accuracy	1 kHz
Frequency stability	+/−35 Hz/hr
Remarks	Ingenious design, modular construction. Has motor driven, tuned preselector. Excellent reception qualities, excellent sound. 60 memories are provided. Has clock and multiple timer. Very solid, but expensive.

RF-section

		Bandwidth		
	Frequency	wide	narrow	SSB
Sensitivity in µV for 26 dB	.15 MHz	38	34	–
S+N/N below 2 MHz	.50 MHz	29	24	–
	1.00 MHz	26	23	–
Sensitivity in µV for 10 dB	1.50 MHz	22	19	–
S+N/N above 2 MHz	2.00 MHz	1.9	1.6	1.2
	3.00 MHz	1.6	1.3	.9
Modulation 400 Hz at 30%	5.00 MHz	1.5	1.3	.8
	7.00 MHz	1.5	1.3	.7
	10.00 MHz	1.5	1.4	.7
	20.00 MHz	1.5	1.3	.7
	30.00 MHz	1.5	1.3	.8

	SSB	normal	narrow
Bandwidth at −6/−60 dB in +/− kHz	2.6/6.2	4.8/14.1	2.6/6.2

Image rejection	72 dB
AGC range	88 dB
ICP 3. order	−7 dBm
Dynamic range	91 dB
Tuning indicator	S1 7µV
	midscale 150µV
	end 3.5mV
Antennas	telescope 145 cm, ferrite rod
Antenna connectors	non-standard coax for all frequency ranges
	Clamps (antenna and ground) for LW, BCB, SW
Remarks	Built-in antennas can be switched off

AF section

Audio power	9.5 watts (27 watts peak) at 10% THD (mains)
Audio frequency range	82 Hz – 13.5 kHz (+/−3 dB points)
Tone control	separate for bass and treble, +/−8 dB each
Noise limiter	yes
Speaker	combined bass/midrange, separate tweeter
Connections	external speaker, earphone, record, playback others see text

General

Power supply	110 or 220 VAC or 10 to 15 VDC
Power consumption	AC 16 VA, DC 7 VA
Dimensions	50.5 × 24.5 × 20.5 WHD in centimeters
Weight	approx. 9.1 kg (batteries installed)
Accessories	manual, frequency list, SWL primer
Price	approx. US$1,000

Miscellaneous

FM sensitivity	1.4 µV for 20 dB SINAD
Spurious signals	58 dB below wanted signal (worst case)
Accuracy of clock	+14 seconds/month

Grundig Satellit 650/600

Grundig introduced a successor to the Satellit 600 early in 1986. The new Satellit 650 has only minor circuit changes, but different looks.

Satellit 650 vs. Satellit 600

The old model may still be available in large quantities. Except for a marginal increase in performance and the addition of a front panel input for a marine-band directional antenna, both sets are almost identical. The new Satellit 650 is, however, geared for export. The model sold in Europe (Satellit professional 650) is limited in its SW coverage to 26.1 MHz, according to restrictions set by postal authorities in West Germany. The export version (Satellit international 650) has full SW coverage up to 30 MHz.

Unfortunately, Grundig uses a strange type of coax connectors for main and directional antennas in these sets. The sockets are built to connect with a type of plug rarely found outside of Europe. If you plan to buy one of those receivers, don't despair. The corresponding plugs are available through Gilfer Associates at nominal cost.

The following report covers the Satellit international 650, but most of the statements are equally valid for the older version, i.e. Satellit professional 600. Both sets are without competition in their class and/or price range. They are extremely well built, easy to operate, and offer a level of performance which must be compared to full-scale communications-type receivers like FRG-8800 or CRF-1. In addition to outstanding shortwave capabilities, these large Grundigs have a truly excellent audio section, full FM coverage, and several other features which are rarely found in portable radios.

Black Giant

This is not a portable in the true sense of this word. The set is very large, very heavy (more than 20 lbs) and can not be carried around easily. However, the sturdy recessed carrying handle will ease transport problems. Guard rails at the front have

been provided to protect the control elements. The entire cabinet is made of a special, very hard plastic material. Inside, the circuit boards are separated as to their respective functions. Test points are provided and most internal connections are made with plug-in connectors and ribbon cable. An enormous amount of shielding has been used, up to and including special conductive paint on certain parts of the cabinet insides.

The revolving turret tuner, a tradition with all Satellites since 1960, is missing in this new receiver. Modern technology is used where it counts. Frequency generation utilizes a dual phase locked loop (PLL) synthesizer, frequencies are indicated on a large liquid crystal display (LCD). The receiver works as double superhet on all AM ranges, i.e., longwave, medium wave (BCB), and shortwave. A dual balanced mixer is used to generate the 1st IF, the following filter is of the monolithic crystal type to insure good transfer characteristics to the following sections. The intermediate frequencies are 54.5 MHz and 450 kHz.

Grundig, however, didn't depart from analog technology entirely: most of the control elements have been retained as either old fashioned knobs or switches. Form and functions of the lower row of controls were copied from the old Satellit 3000/3400, which were very capable receivers.

The SSB mode of operation may be set separately for USB or LSB; the beat frequency oscillator (BFO) has a tuning range of +/−1 kHz. A three position bandwidth switch and a manual control for RF gain adjustment are provided.

Traditionally, the Satellit series has always lots of audio power and an impressive set of loudspeakers. Here we have a combined bass/midrange unit and a separate tweeter (switchable) which are powered by an amplifier rated at 30 watts peak output when the radio is running with mains power.

There are more features:

- automatic noise limiter = ANL
- built-in antennas for all ranges (defeatable)
- front panel input for a marine band directional antenna
- rear panel inputs for high and low impedance antennas
- outputs for tape recording (DIN and cinch)
- audio input for playback (DIN and cinch)
- timer control of certain Grundig cassette recorders
- battery check function
- multi-purpose digital clock and timer
- output jack (DIN) for an external speaker

The Satellit 650 may be operated on six D size batteries, while memory and clock circuits require two additional AA cells. The built-in power supply can be adjusted for inputs of either 110 or 220 VAC, or external DC power in the range of 10 to 15 VDC may be used. Clever hobbyists will welcome the charging circuit for an optional accumulator. This rechargable battery fits right into the battery compartment. The mains cord can be stored inside the cabinet. AC operation illuminates all scales and dials automatically; a switch is provided for this purpose when the set is powered by batteries. The LCD shows the time when the radio is switched off, the display is dimly illuminated when the radio is "OFF" but remains connected to a mains source.

The digital clock can display hours, minutes and seconds (24 hour format, of course), or the date. Three separate on/off times may be programmed into the timer. With a special connector cable (STK 227), certain cassette recorders from Grundig can do automatic recording under timer control.

Black Magic

The Satellit 650 (and 600) boasts an innovative masterpiece: a fully automatic, motor driven preselector. This is a technological 'tour de force' unique in this class of receivers. This elaborate preselection (tuned front-end) insures excellent performance in crowded bands, as it passes only a narrow portion (approx. +/−50 kHz) around the selected frequency to the preamplifier/mixer. The upper large analog dial is assigned to this circuit. Frequency scales for LW, MW, and SW are provided here, but only the center frequencies of broadcast and ham bands are shown. In automatic mode a small electric motor turns the tuning elements of the preselector towards resonance, according to the frequency shown on the LCD. The motor drive electronics get their information from the microprocessor which controls the frequency display. This digital data is converted to a certain amount of drive power (revolutions) of the motor. A full-scale digital to analog converter (D/A converter) is used, with its own calibration program to insure pinpoint accuracy under all conceivable conditions. It's like magic to see the pointer move on the scale as soon as a new frequency is entered. Frequencies are selected either with the tuning knob (manual tuning), the keyboard (direct access tuning), or by memory recall.

1. Manual tuning

The inner (large) portion of the rotary controls will select frequencies as in any old-fashioned radio. But again, there is lots of electronic wizardry behind this innocent looking knob. Tuning steps are exactly 1 kHz on all AM ranges, but 10 kHz on FM. The knob actuates an electronic circuit which causes the synthesizer to step either 1 kHz/10 kHz up or down. There are magnetic detents for each step. Tuning speed (step size) is increased dramatically when the tuning knob is turned quickly. Audio is muted in this case, but will come back automatically when the knob remains motionless for a second or so.

2. Direct access tuning

When the large key marked FREQ is actuated, any value entered previously with the keyboard is considered a frequency input and the radio tunes to this frequency instantaneously.

Example: Enter the sequence 1 5 4 3 0 and depress FREQ momentarily. The receiver tunes to 15.430 MHz within fractions of a second; simultaneously the preselector dial pointer moves to a spot on the dial which corresponds to this frequency. During the entire tuning process, audio is muted. The sound comes back gradually (soft fade-in) when everything is o.k. There is a drawback to this ingenious scheme: It will work only, when the correct frequency range (LW, MW, SW, FM) was selected *before* telling the microprocessor to perform automatic tuning. Also, the preselector must be set to 'automatic' (shown on the LCD) to be able to follow the commands from its drive circuit. Manual preselector tuning is also possible and recommended in certain situations.

3. Memory recall

The keyboard can access a total of 60 memories, distributed as follows:

- Shortwave 32 frequencies
- Mediumwave (BCB) 18 frequencies
- Longwave 4 frequencies
- FM 16 frequencies.

Programming is very easy, but again, the correct frequency range must be set manually on recall.

Upon changing the band, the last frequency used in this band is tuned automatically.

Preselector fine tuning may be accomplished with the forward (smaller) portion of the tuning knob. The large black front cover is the mode selector for either automatic or manual operation. Manual correction can be used at any time, even when the preselector is on automatic: there is a sturdy friction clutch inside this knob. The preselector will also follow a manual frequency adjustment fully automatically, when set to "automatic."

In practical operation, manual intervention is frequently required. The drive cir-

cuit does not always match the tuning point of the preselector to the indicated frequency of the receiver section.

Good reception, excellent sound

This new Grundig is a reliable receiver with lots of signal pulling power. The synthesizer section is very quiet, intrinsic noise is barely noticeable on empty band sections. A somewhat deceptive silence is all you hear from the speaker. This is a common sign for low sensitivity, but just the opposite is the case. Usable sensitivity in this set is excellent and there are no problems when working in crowded bands. The ICP 3rd order was measured at −5 dBm, the dynamic range is 92 dB: a result of the clean design of both preselector and mixer. Difficult situations can be handled with the combinatorial effects of manual RF gain, manual preselector tuning, and a change of IF bandwidth.

Effective selectivity will separate two adjacent channels (5 kHz spacing) nicely, but a strong station may come through faintly on neighboring empty channels. SSB reception is excellent from the adjustment point of view, although a better filter is needed for satisfying performance in the overcrowded ham bands.

The ANL function is quite interesting; very noisy transmissions may be improved by the resulting drop in background noise of about 3 dB when this function is activated. The display areas for signal strength, frequency, and preselector tuning are angled for non-glare viewing. The large signal strength indicator gives meaningful readings, but unfortunately a non-standard scale is used.

External antennas can be used without problems, with the possible exception of certain active (electronically amplified) antennas which deliver just a bit too much input to the front end. I didn't have any problems with either ara-30 (Dressler) or AD-370 (Datong).

Getting used to the control logic of the preselector is probably the weakest point. Even after some weeks one forgets and leaves the mode selector set to 'manual' when entering a frequency or recalling from memory. Of course, the frequency is set properly, but nothing can be heard because the preselector has not tuned. I'd prefer a forced automatic mode when in memory operation. Additionally, it is very important to retune this preselector manually when working weak signals. Signal strength (and quality) may be improved by up to two S-units.

The microprocessor controlled logic mutes audio when the tuning knob is turned rapidly. This means, many stations which would be heard during normal (slow) tuning are by-passed. This in turn forces the operator to tune very slowly, quite an advantage, if you care for my opinion.

The Satellit 650 produces the most amazing fidelity from AM modulated signals, without exotic circuitry like a synchro-phase detector. One must simply hear this set on a clear frequency to believe, that the audio was extracted from a limited bandwidth shortwave signal. BCB signals sound still better, and you can really entertain a crowd with your favourite FM station and the immense audio output power. Intelligent memory assignment permits the owner to set up or recall a complete listening schedule within minutes.

Rating

The Satellit 650 is a large, solid, and utterly reliable radio with impressive looks. Performance, features, and workmanship are good to excellent. This really is a respectable receiver for all wave bands. The rather plain appearance hides exceptional operating comforts and innovative technical solutions. The set lives up to expectations within this price range. On the other hand, this radio is not expressly suited for any specialized SSB transmissions, e.g. RTTY, FAX, etc. SSB voice signals (A3J) come in clearly, but are not as crisp and clean as in other specialized receivers. As long as casual listening to maritime and amateur traffic is done besides DXing and/or SWLing, this multi-purpose receiver may fullfil most of your dreams.

Remarks

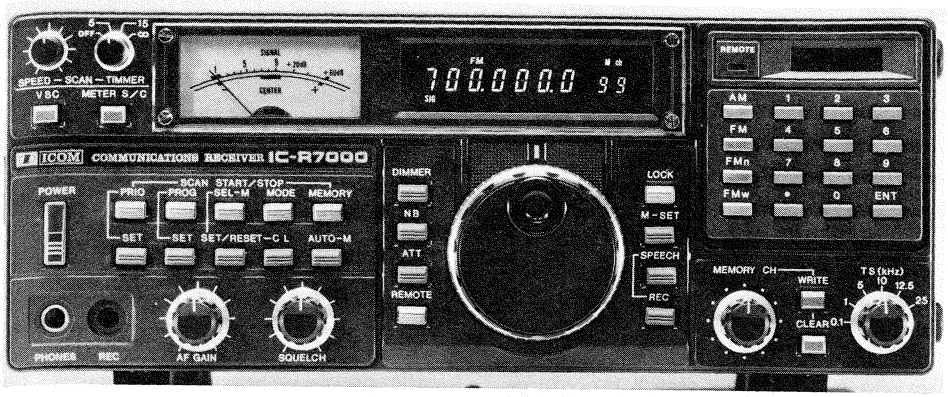
The Satellit 650 was built with the yachtsmen in mind. A simple directional loop (or a ferrite-antenna) can be used with the DF-input to determine relative direction to a beacon or any other known RF source below 4 MHz. Some experience is needed to use this feature, e.g. manual RF gain control is mandatory.

The extreme flexibility of power supplies, the large audio output power, and the convenient and unambiguous operation are a considerable advantage in maritime environments.

The set has threaded sockets in the bottom, which allow secure fastening on a shelf or any other suitable surface. The necessary bolts are 5mm metric, with a length of up to 19mm.

Icom IC-R7000

Type of receiver	VHF/UHF communications receiver/scanner
Frequency range	25 MHz, to 2000 MHz
Modes	AM, FM, SSB
Bandwidth (at −6 dB)	FM narrow +/−7.5 kHz, FM wide +/−75 kHz AM narrow +/−3.1 kHz, AM wide +/−7.5 kHz SSB +/−1.4 kHz
Circuit type	dual, triple or quadruple conversion, see text
IF frequencies	778.7 MHz, 266.7 MHz, 10.7 MHz, 455 kHz
Image rejection	typically 62 dB
Sensitivity for 10 dB S+N/	FM narrow .38 μV, FM wide 1.1 μV AM narrow .75 μV, AM wide 1.2 μV, SSB .35 μV
Tuning steps	.1, 1, 5, 10, 12.5, 25 kHz; all modes
Frequency display	numeric, 100 Hz resolution
Memories	99, for frequency and mode
Audio power	2.3 watts at 10% THD, into 8 ohms
Dimensions	29 × 12 × 28 WHD in cm
Weight	8.1 kg (17.8 lbs.)
Power required	110 VAC or 13.8 VDC at 1.6 A
Accessories	manual, fuses, plugs, schematic
Options	synthesized speech module IC-EX 310 infrared remote control RC-12 speaker IC-SP3
Price	List: US$1,099.00



Icom IC-R7000

No doubt, this is the superscanner of the decade. The IC-R7000 looks deceivingly like an expensive shortwave receiver, but in reality this is an extremely versatile scanner/receiver with extended frequency range.

Simply fantastic

This fine piece of equipment covers the unbelievable range from 25 MHz to about 2000 MHz (2 GHz), with a small gap between 1000 MHz and 1025 MHz. All modes are available, i.e. AM (A3E), SSB (A3J), and narrow band FM (F3E). There also is a wide band FM mode for broadcast reception. Separate IF-filters are available for each mode. The following choices can be made:

- AM wide +/−7.5 kHz/−6 dB
- AM narrow +/−3.0 kHz/−6 dB
- SSB +/−1.4 kHz/−6 dB
- FM wide +/−75.0 kHz or +/−7.5 kHz at −6 dB
- FM narrow +/−7.5 kHz or +/−3.0 kHz at −6 dB

If this flexibility doesn't suffice, there is a connector on the rear which carries one of the IF-signals for further processing.

Frequency and other pertinent informations are displayed on a blue/white vacuum fluorescent tube. This assures readability under most lighting conditions. The intensity can be reduced to a very moderate level. This is an important convenience when one is working in dimly lit surroundings. The multitude of functions is simply overwhelming, the number of buttons and switches gives some indication that almost everything is possible with this receiver/scanner. A close study of the excellent handbook is mandatory and expressly recommended. In case you're interested, here is a list of what the R7000 can do:

- scan a certain, programmable frequency range
- scan programmable memories
- scan all memories
- scan only for memorized frequencies which carry traffic
- scan only memories with a programmed mode of operation
- search in a programmable frequency range and write active channels automatically into memory (20 channels maximum)

Frequencies can be accessed directly via keyboard input, recalled from one of 99 memories, or tuned manually. The memory section has a back-up lithium battery with an extended life span of about 5 years (owner replaceable).

Of course, several other scanners have some or most of these functions. But, you can also search a range of interest with manual tuning while keeping the squelch threshold very low. This way, you'll come across quite a few stations which are not caught by automatic search procedures. To make scanning a realistic process, the squelch must be turned up a bit, otherwise the signal detector will stop on any spurious signal or noise. The squelch setting can be read on the large and brightly illuminated S-meter. For accurate tuning of FM signals, this meter can be switched to show center tuning, like those meters used in expensive stereo equipment. Manual tuning is accomplished with a large, extremely well balanced tuning knob. This knob's friction can be adjusted with a small screwdriver. For all modes (manual and scan) the following steps are selectable: .1, 1, 5, 10, 12.5, and 25 kHz. The setting can be read from the TS control. A priority channel may be programmed and—upon activation of this function—will be monitored in intervals of .4 seconds, regardless of whatever you are doing with the receiver. Of course the scanner can be told to either stay on an active channel or remain there only for a certain amount of time. Also, the speed of scanning is adjustable. The scanner can be set to look only for channels with voice traffic. This feature passes over most of the carrier signals often found in the VHF/UHF range. "Scan delay" sets delay times for restarting scanning after an incoming signal ceases. With about five seconds delay, you'll catch most of the replies on the same channel.

99 memories for frequency and mode are available. If that doesn't suffice, an interface connector is provided which can be used to make this receiver part of a computerized setup, with almost unlimited possibilities. The interface works with standard RS-232C levels, so there should be no problem in using most personal computers.

Probably the most interesting feature is the ability to record a spoken frequency announcement (synthetic voice) together with the signal received when the scanner stopped. Just think about that, you can set the R7000 to scan a certain frequency range (or memories) for an elusive signal. When it is caught, it is recorded along with the precise frequency. Thereafter, the scanner resumes its surveillance. the synthesized voice comes out of an optional circuit board (IC-EX 310) which is easy to install. The cost is moderate, this option is recommended. Another interesting option is the infrared remote control. The small hand-held transmitter box gives access to most of the receiver's functions.

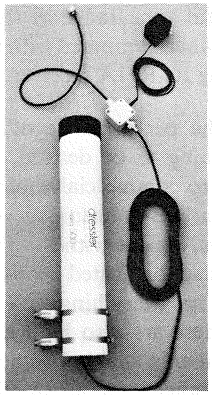
The spoken frequency announcement is also available when the receiver is operated in its normal mode, just hit the button marked SPEECH. The speed of the synthesizer is adjustable, so is the volume.

There are several other features worth mentioning:

- noise blanker
- attenuator
- tuning lock
- front panel connectors for headphones and recording

On the rear a variety of connectors can be found: external speaker, start/stop control for a tape recorder, and the already mentioned cinch jack with the 10.7 MHz IF output. Since the front panel couldn't carry any more controls, several switches were moved to the back. These are LSB/USB selection, activation of synthesized voice output to recorder, and an additional FM bandwidth selector. The familiar ground clamp is there, and a recessed socket for a detachable mains cord. True to style, the antenna input is a commercial grade N-connector, not the standard (and lossy) UHF variety. The input impedance is specified at 50 ohms, and that's exactly what was measured in the lab. For those who like to extend the possibilities of this receiver a connector for computer interfacing is provided. Lastly, a spare cinch connector can be used to feed other signals into or out of the R7000.

This receiver is well made, both inside and out. The functions are clearly labelled; all knobs, switches and pushbuttons are of above average quality. A look at the innards shows almost professional quality, with heavy shielding around critical circuits.



The R7000 uses a complex frequency conversion scheme. In the range from 25 MHz to 512 MHz the following IF-frequencies are employed: 778.7 MHz, 10.7 MHz, and 455 kHz. From 512 MHz to 999.9999 MHz, 1st IF is changed to 266.7 MHz, the other IF frequencies remain the same. A crystal controlled converter is used to cover the amateur region from 1240 MHz to 1300 MHz. Conceptwise, this is now a quadruple conversion superheterodyne. There is one exception, though: when FM wide is selected, the receiving system is dual conversion, except from 1240 MHz to 1300 MHz where a triple conversion is done.

Frequencies above 999.9999 MHz are reached by pushing the little button marked 1 GHz. This activates an additional converter unit (frequency doubler). The indicated frequency is read as (value indicated plus 1 GHz). Specifications are guaranteed up to 1300 MHz. On ranges beyond, sensitivity is somewhat reduced.

The local oscillator is controlled by a dual phase locked loop. The block diagram shows a clean, professional approach, the design is well executed.

There is some minor omission, though. The vast frequency range accessible with this receiver can hardly be covered by a single antenna. Since there is only one antenna connector, separate antennas must be channelled through a discrete selector switch. I'd prefer a built-in switching arrangement for at least two antennas.

The various operational settings and their combinations for manual tuning, automatic tuning, programmed scanning, etc. can not be covered adequately in this article. The handbook devotes about 30 pages to explicit instructions, with lots of drawings, examples, and tables. This handbook is really well made, not some of those Japanese-English mistreatments of complicated subject matter.

Fantastically simple

A good test of a sound operating concept is to find out whether I can operate the set in its basic mode without having to use the handbook. If this is not possible, then the layout, labelling, and functions of the controls are not sound. Well, the R7000 can be operated this way. Just read the front panel and obviously, TS means Tuning Step, ATT stands for attenuator, NB for noise blanker, etc. Mode pushbuttons and the large tuning knob are self explanatory. For memory access and most other special functions one simply has to consult the manual. As a matter of fact, some features are rather intricate, so some dry runs should be made with book in hand before the set is put into actual operation. But, after a few hours, this versatile receiver/scanner is as easy to operate as any shortwave rig.

In actual hands-on tests, the R7000 proved to be a first class piece of equipment. Sensitivity is outstanding, cross- and intermodulation effects were not noticeable "on the air." In the laboratory, the data was equally convincing. I had a Yaesu FRG-9600 running at the same time, so a side by side comparison was inevitable. Both scanners were connected to Dressler's ara-500 wideband active antenna. I also had several specialized antennas for the 2 m and 70 cm ham bands at my disposal. Receivers of this kind can not be operated successfully with auxiliary antennas, e.g. a few feet of wire or a makeshift whip aerial.

The pronounced background noise (hiss) is a characteristic of UHF/VHF receivers, the squelch control soon becomes one of the frequently used knobs. A fairly large speaker is built into the top of the cabinet. The sound is very clear, very crisp, and I urge you to try an external speaker of adequate quality, e.g. Icom IC-SP3. You'll soon notice the excellent and quite powerful audio section. The large and well illuminated signal strength indicator is vastly superior to the newer graphic displays. Since both Yaesu's and Icom's meters are accurately calibrated, a direct comparison of signal pulling power could be made. On the average, the Icom R7000 was at least one S-unit better. At this price and considering the more elaborate circuitry, this came not as a surprise. On the contrary, all things considered, the performance of the tiny FRG-9600 was quite surprising. But of course, the IC-R7000 is the better receiver, and it also offers more features. Under critical conditions, the Icom produced the better signal, and could catch weak signals in the VHF-range which were not even noticed by the Yaesu.

Soon the location of the LSB/USB switch on the rear became a nuisance. This control is used frequently when monitoring ham traffic. All modes of modulation are employed there, and when the Icom is mounted flush into a panel or set into furniture this control is not readily accessible.

The flexible FM bandwidth switching is very helpful. But again, the changeover switch for the auxiliary settings is located on the rear. These are minor inconveniences, they are compensated somewhat by the beautiful appearance of this receiver, especially when combined with the identically looking IC-R71A receiver.

Overall, the performance of the R7000 leaves nothing to be desired, even when compared to commercial equipment, e.g. my old Watkins-Johnson surveillance receiver. (Yes, the one with the plug-in modules.) This sophisticated receiver/scanner from Icom has everything, and if that's not enough, there are also high quality converters available which give access to the frequency range from below 10 kHz to 30 MHz. Incidentally, the R7000 can be operated on DC power. 13.8 VDC at about 1,5 A are needed, and a special cable (available from Icom). The IC-R7000 is indeed the best scanner/receiver presently available. Commercial units with this level of performance cost close to US$ 20,000.–, and that's just the starters kit. So this receiver is a good buy. You'll never need another scanner, the R7000 does it all, reliably, efficiently, and quite handsomely, too.

JRC NRD-525
Class of '86

A sophisticated all-wave receiver was introduced by Japan Radio Corporation early in 1986. The set uses advanced technology, has a unique approach to expandability, and is—all things considered—offered at a tempting price.

A new start,—and the end of an era

When I wrote about JRC's NRD-515 early in 1979 I stated, that this radio would probably set the standard for years to come. I was right, in subsequent years no receiver with comparable performance, solidity, and ease of operation was built. This remains my opinion, which is not quite changed by this capable (but more complex) newcomer.

The new NRD-525 clearly shows, that the latest models from Yaesu and Icom were an incentive for JRC's development, although this NRD-525 is patterned after a commercial receiver named NRD-93. I am not talking about performance (there is plenty), I am talking about features. The front panel is virtually studded with controls, and the back of this receiver is nicely decorated, too. Wherever you look, there is a little knob, button, or jack, and the question arises "Is all this really necessary?". Of course, a closer look at the features provided by the all-new NRD-525 must precede a further analysis.

An interesting concept

The NRD-525 presents a modular approach to receiver design by putting most of the electronic circuits on easily replaceable vertical plug-in boards. The standard configuration uses seven boards, there is

JRC NRD-525

Manufacturer	Japan Radio Corporation, Tokyo, Japan
Type of receiver	communications type, stationary
Type of circuit	double superheterodyne, PLL synthesizer
Frequency coverage	90 kHz – 34 MHz, other ranges optional
Display accuracy	10 Hz
Frequency stability	+/– 5 Hz/hr
Remarks	Advanced design, modular construction. Has tuned preselector, excellent reception qualities. Uses synchronous detector on AM. 200 memories are provided. Has PBT and notch filter.

RF-section

	Frequency	Bandwidth wide	narrow	SSB
Sensitivity in μV for 10 dB	.15 MHz	18	14	–
S+N/N AM modulation with	.50 MHz	19	14	–
400 Hz at 30%	1.00 MHz	16	13	–
	3.00 MHz	2.2	1.6	.5
	5.00 MHz	2.2	1.5	.5
	7.00 MHz	2.0	1.5	.5
	10.00 MHz	1.8	1.4	.4
	20.00 MHz	2.0	1.5	.5
	30.00 MHz	2.2	1.7	.6

Bandwidth at –6/–60 dB	wide	normal	narrow
in +/– kHz	3.8/9.8	2.1/5.6	1.2/2.8

Image rejection	–72 dB
AGC range	92 dB
ICP 3. order	+15 dBm
Dynamic range	102 dB
Tuning indicator	S1 1.2μV
	S9 45.5μV
	end 35.0 μV
Antennas	none built in
Antenna connectors	coax SO-239 (UHF) for all frequency ranges
	Clamps (antenna and ground) for LW, BCB, SW
Remarks	Antenna input may be switched from wire to coax input. 20 dB attenuator provided.

AF section

Audio power	.45 watts at 10% THD
Audio frequency range	110 Hz – 7.5 kHz (+/– 3 dB points)
Tone control	+/– 8 dB at 1 kHz
Noise limiter	yes, level and width are adjustable
Speaker	3.5", 1 watt
Connections	external speaker, earphone, line, record others see text

General

Power supply	110 or 240 VAC or 13.8 VDC
Power consumption	AC 36 VA, DC 27 VA
Dimensions	33 × 13 × 28 WHD in centimeters
Weight	approx. 8.4 kg (no options installed)
Accessories	manual, schematics, fuses, connectors
Price	approx. US$ 1300.-

Miscellaneous

FM sensitivity	1.4 μV for 20 dB SINAD
FM bandwidth	narrow band FM only : 14 kHz
Passband shift	+/– 1.6 kHz
Notch attenuation	single tone : – 32 dB
Spurious signals	65 dB below wanted signal (worst case)
Accuracy of clock	+4 seconds/month

Options	CMK-165	VHF/UHF converter
	CMH-530	RTTY demodulator
	CMH-532	RS-232C interface
	NVA-88	speaker
	ST-3	headphones
	6ZCJD00139	printer cable
	6ZCSD00140	RS-232 cable
	CFL-231	.3 kHz filter
	CFL-232	.5 kHz filter
	CFL-233	1 kHz filter
	CFL-218	2 kHz filter

room for five more (options). The basic radio covers a frequency range from 10 kHz to 34 MHz with continuous tuning. Bandswitching is not required. With additional boards the ranges from 34 to 60 MHz, 114 to 174 MHz, and 423 to 456 MHz become accessible. The expansion is easy, all necessary provisions have been made, up to and including two holes for separate antennae jacks (UHF and VHF). The receiving section is built around a very cleverly and efficiently designed dual superhet configuration, having a 1st IF of 70.455 MHz and a 2nd IF of 455 kHz. The RF/IF section shows all attributes which one has come to expect in a first class receiver: coax antenna input, switchable attenuator, tuned preselector, pre-amplifier, dual balanced mixer, quartz filter in 1st IF output, buffered IF amplification, another balanced mixer for conversion to the 2nd IF, elaborate filters, and signal processing with passband tuning and notch filter.

Of course, there is a product detector for SSB, and – not quite expected – the ingenious synchronous AM detector. 200 memories for frequency, mode, filter, AGC, and ATT are built-in. Display accuracy and settability of frequencies is 10 Hz (!). The blue fluorescent display is easy to read, it can be dimmed or switched off completely. This multi-purpose display shows all operational settings in plain english.

The following options (at extra cost) are offered:

- VHF/UHF converter for the ranges mentioned above
- RTTY converter (filter type) with printer output (Centronics standard). Accommodates 45 or 50 baud, at shifts of 170, 425, or 850 Hz, normal or reverse polarity. These functions are settable with keyboard sequences.
- RS-232C interface to facilitate the connection to a personal computer
- matching speaker
- various user-installable filters (2nd IF only)

The basic set comes with two filters already installed. These are units with 6 kHz and 3 kHz bandwidth at –6 dB, respectively. In addition, there is a setting which bypasses the entire filter bank, thereby yielding a response in excess of 12 kHz (at –6 dB). The magnificent fluorescent display has been wired to show the following:

- frequency with either 10 Hz or 100 Hz resolution
- mode (RTTY, CW, FAX, USB, LSB, AM, FM)
- filter selected (one of four)
- AGC timing (slow, fast, off)
- signal strength up to S9+50 dB
- memory channel (001 to 200)
- time 1, time 2, programmed on-time, programmed off-time
- RIT (when selected)
- MONI (when selected)
- TIMER (when radio is in stand-by under timer control)
- SQL (squelch activated)
- PAUSE (when signal is above level set with P. LEVEL)
- REMOTE (when receiver is under computer control)

- MR (when frequency was read from memory)
- PASS (when automatic preselector is bypassed)
- ATT (when resistive attenuator is activated)
- RUN (when SCAN or SWEEP are started)
- START and END for setting SCAN or SWEEP boundaries

The controls on the front panel are mostly self-explanatory by their legends, therefore I'll just cover the more unusual features:

RIT switches to vernier tuning (receiver incremental tuning). The frequency display is cancelled and only the deviation from this frequency is shown. Tuning range in this mode is +/−5 kHz around the previously selected frequency.

BFO adjusts the pitch of CW signals. The tuning range is +/−2 kHz.

MONI(TOR) allows the operator to listen to his own voice signals when this receiver is used in a receive/transmit setup. The level is internally adjustable.

SCAN looks for signals on preset memory channels.

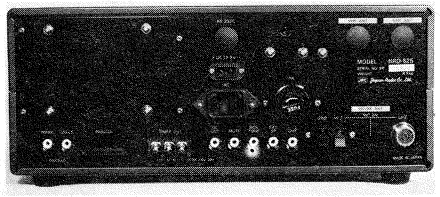
SWEEP looks for signals within a certain programmable frequency range.

Speed and stop level may be set for both functions (scan and sweep) with *SPEED and P. LEVEL* (pause level). The range is adjustable from 65 kHz or 14 channels to 1,250 kHz or 140 channels per minute.

PBS (passband shift) allows for shifting the contents of the 2nd IF signal through the characteristic of the selected IF filter.

NOTCH can be used to eliminate a single interfering tone from the audio output. The frequency of this filter is adjustable. (Note: The actual notch circuit itself works on the 2nd intermediate frequency!)

SQUELCH sets a certain level which must be overcome by the received signal in order to become audible.



MODE is used to select the operating mode desired (AM, SSB, FM, etc.)

BANDWIDTH switches the desired filter into the 2nd IF chain. Both adjustments may be made either way, you don't have to sequentially step through all the settings to reach the desired action.

UP and DOWN allow for tuning in steps of 1 kHz (up or down) or—when in memory mode—may be used to change the memory channel in use.

LOCK disables the entire control section, thereby freezing all operational settings.

The touch-pad may be used to input either frequency or memory channel. It is possible to input frequencies in MHz format, e.g. 17.455 MHz, or in kHz format, e.g. 17455 kHz, by hitting the appropriate button after the numbers are entered. There are also some user-programmable functions accessible with certain keystroke sequences. The internal beeper can be disabled this way, or the display (and tuning) can be programmed to reflect a (non-existent) carrier in SSB signals. Also, the display accuracy may be changed to 100 Hz or 10 Hz resolution.

The back of the set looks equally impressive. Here you'll find an impressive array of connectors:

- MARK/SPACE outputs for connection to an oscilloscope (or similar device) to indicate correct RTTY tuning
- TIMER OUT controls a recording device. The relay contacts may be used to either close or open when the built-in timer is activated.
- DC OUT feeds 11 VDC at 30 mA max. to an external device of your choice, e.g. an active antenna.

- MUTE blocks the receiver when connected to an active transmitter
- SIDE (tone) allows for monitoring a CW signal from your own transmitter
- SPEAKER is the audio output for an external reproducer
- LINE is a high level audio output for recording or processing. The level is set to 0 dBm at 600 Ohms (internally adjustable)

There are independent SO-239 coax connectors for all frequency ranges when the UHF/VHF boards are installed. In addition, the usual clamps for high impedance antennas are provided (90 kHz to 34 MHz only).

The RS-232 connector is used to control the NRD-525 with a personal computer.

- PRINTER feeds ASCII codes in Centronics standard to your printer when the RTTY option is installed. The RTTY board and the RS-232 board may be used in conjunction.

The power supply can accommodate various line voltages (export version), the set can also be operated on voltages from 12 to 15 VDC. The power supply must be able to deliver 2 Amps continuously.

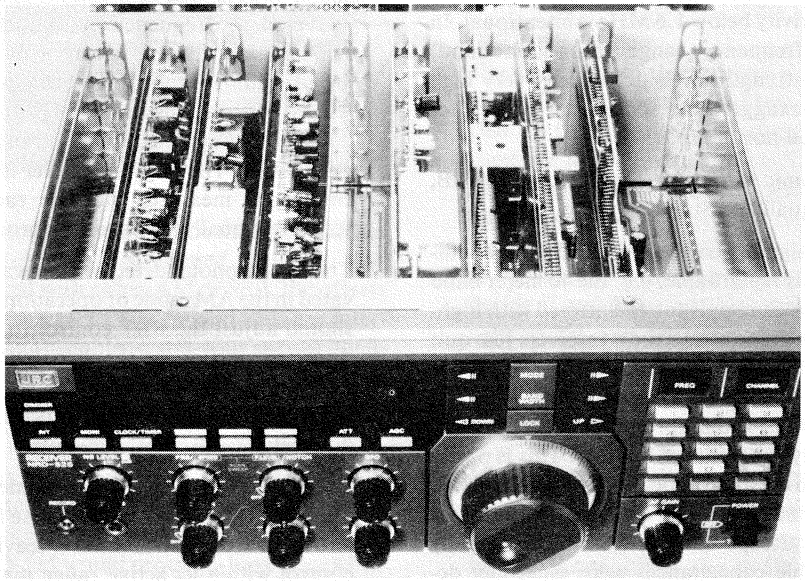
The entire package—and a nice one it is—shows above average quality and workmanship. First class components are used on the circuit boards. The finish is excellent. The competitive price of this radio was made possible by borrowing heavily from existing technology and the use of advanced production methods. However, a very close look reveals, that the NRD-525 can not quite match the standard set by its predecessors NRD-505 and NRD-515. Quite subjectively however, this new receiver still remains a class above anything offered in or close to this price range.

The handbook (owners manual) is concise and to the point. Schematics are provided, although do-it-yourself troubleshooting seems to become a rather difficult affair if you don't have the necessary adaptors for the plug-in boards.

The NRD-525 is offered at around US $1300. It is well worth this price.

New dimension

The NRD-525 is—despite the many controls and features—easy and straightfor-



ward to operate. Of course, some familiarization is required, but after two hours or so you'll not have to consult the manual anymore. All knobs and buttons function to perfection, the action is very positive. The knobs are just large enough to be handled with comfort. The lettering on the front panel is clearly legible, except for the bottom row of buttons in the left center.

The tuning accuracy (and the matching display) are impressive indeed. Still the more impressive is this receiver's frequency stability. Drift is virtually non-existent, it was measured at less than 5 Hz/hour. This is most important for utility fans, where utmost stability is required when dissecting the complex new RTTY signals.

All so called "specialists" take note: Here at last is a receiver which is a match to their beloved monster Collins R390A/URR. Indeed, in my tests the NRD-525 compared favourably with receivers of truly professional calibre: Rhode & Schwarz EK 070 and Siemens E530.

ICP 3rd order was measured at +17 dBM (at 7 MHz) and +14 dBm (at 25 MHz). These are excellent values, and they are not the result of decreased sensitivity. The NRD-525 is among the most sensitive receivers I've measured so far. The reduced sensitivity below 1.6 MHz is intentional. In this frequency range (broadcast band) field strength levels are usually very high and exaggerated sensitivity is neither needed nor desired.

Dynamic range was computed to 102 dB, an equally outstanding value.

The signal quality under adverse conditions is remarkable, e.g. the 40 meter band here in Europe is fairly cluttered with high-power stations and most receivers just quit when you try to extract some intelligence from a weak radio-amateur signal. The NRD-525 is unimpressed and functions in a truly professional manner. This is partly due to the automatically tuned preselector. The manufacturer expressly states, that the varicaps (diodes with electronically variable capacitance) were especially designed for that purpose. They will not cause cross- or intermodulation which most non-linear components at this point in the circuit would surely do. If you don't trust this electronic marvel, just hit MEMO and 4 to bypass this preselector. The loss of the circuit is around 2 dB, so this may be a worthwhile feature when hunting for extremely weak signals.

SSB comes in very clean, very distortion free and the pitch is easily controlled by using either main tuning or RIT. The notch filter works to perfection, when measured separately a single tone attenuation of more than 30 dB was achieved. Of course, PBT must be used with caution when narrow filters are switched in. When used conscientiously, PBT can clean up an "unreadable" signal to an extent you won't believe. Depending on signal conditions (external noise, interference, signal splatter, etc.) the background noise can be reduced substantially. On AM signals, the combination of synchronous detection (either sideband of a dual sideband AM signal), PBT and notch can cope with almost any adverse situation conceivable. PBT is a must when the narrow IF filter is used in the AM mode of operation. Otherwise the AF quality is poor, because the signal sounds mushy and unpleasant. With PBT activated, the frequency distribution of the AF signal is altered, giving a more balanced audio output. But even with the wide filter, stations only 5 kHz apart can be separated by using just a tiny amount of PBT offset. The built-in speaker is just an emergency measure, the fine radio deserves an equally fine sound reproducer.

The synchronous detector is always activated in the AM mode of operation, so you should adjust the PBT control to the less distorted portion of the signal. But normally a setting to either the 11 o'clock (LSB) or the 1 o'clock (USB) position will do nicely.

The notchfilter is activated whenever the knob NOTCH is turned clockwise from its left-hand stop. Careful here, leaving this control within its active range may cause severe distortion on occasion. Use the notch function only when you must. The same can be said for the noise blanker. This is also an active circuit and should be used only as a last resort, e.g. when the woodpecker is obliterating the desired signal.

AGC release times (slow and fast) can cause problems, too. AM signals should be received with the "fast" setting, whereas all SSB signals come out better with "slow". There are, however, exceptions from this rule, e.g. certain types of fast flutter conditions. If the AGC is disabled, i.e. "off", RF gain must be used sparingly. The enormous gain reserves will overdrive and effectively "block" the front end when the control is turned all the way to the right.

If you prefer using the ECSS tuning scheme, the NRD-525 may become your favourite. The frequency readout (and the tuning) may be set to show the carrier frequency. So you can tune to either sideband by just going from LSB to USB with the mode switch. Absolutely no re-tuning is required.

The controlling μP inside the NRD-525 has been cleverly programmed. Any filter may be used with either AM or SSB, the offsets for FAX, RTTY, CW and SSB are internally adjustable to suit your special application. Factory settings are standard values, e.g. 1.5 kHz for SSB.

This receiver is a joy to operate and a joy to listen to. There are, of course, minor shortcomings. I did not like the way those filters are selected. A simple knob as in the NRD-515 would probably have been a better solution. Also, the built-in speaker is really mediocre and an external speaker is simply a must. Tuning across the broadcast bands is a lengthy and tedious affair, because there is only one tuning rate of 2 kHz per revolution of the large tuning knob. Of course, step tuning in increments or decrements of 1 kHz may be used, but this seems to be a rather silly way to tune a receiver of this calibre. The manufacturer has been notified as to the seriousness of this problem. It was voiced by virtually everyone I've seen operating this receiver.

For the time being, you'll probably just set the display to 100 Hz resolution instead of 10 Hz and hit UP and DOWN. This is all I have to criticize. In all other respects, especially in it's electrical performance, the NRD-525 is above reproach.

[Ed. Note: Current production runs have 2-speed tuning on both the "Up-Down" buttons and tuning dial.]

Summary

The new NRD-525 very impressively manifests itself as the No. 1 receiver outside the commercial/military bracket. More than that, this receiver partially matches the reception quality offered by those very costly units.

The flexibility of this receiver is excellent, with adequate operability. I feel, however, that all those built-in functions and features are not really necessary. The manufacturer(s) should stop here and consider what is really needed for truly outstanding performance. Alas, JRC's approach seems to be the only sensible one: Let the buyer decide if and when additional features or capabilities are desirable. None of the knobs and buttons are superfluous, they all have a dedicated function. Indeed, those functions are what one needs in todays crowded band and in the years to come. Performance-wise, the NRD-525 is way ahead of the competition because this receiver delivers outstanding results in all modes of operation. The rivals are excel-

lent on either SSB or AM, but never in both modes. Absolutely marvellous is the modular construction principle. This feature gives all owners the chance to build a personalized receiver which can cope with a variety of demands, including complete computerized control. The price remains a mystery to me, I'd buy this receiver for US$ 1500.—anytime. At around US$ 1300.—this radio is a "BEST BUY".

Recommendations

1) For SWL and casual DX the NRD-525 as delivered will do nicely. For the discriminating DXer and utility fan the optional CFL-218 filter (2 kHz) should be installed.

2) If RTTY and/or CW is your preference, have the CFL-232 (.5 kHz) installed.

3) The optional RTTY demodulator CMH-530 works nicely, only a minimum of interfacing is needed to get a direct printout on Centronics compatible printers.

However, the printer will run and run, you'll use horrendous amounts of paper when tuning up. It is much easier to either feed the parallel printer output to a computer or go all the way and buy the RS-232C interface. This unit allows for internal routing of the demodulated RTTY intelligence, which is then displayed on the computer's monitor.

Kenwood R-5000

This attractive new receiver will eventually replace the unsuccessful R-2000. With it, Kenwood enters the competitive market of higher priced semi-professional equipment.

Good lineage

The promising looking layout of the front panel was borrowed from Kenwood's own TS-440 series. A close look at the schematics reveals a mixed parenthood. Some circuits and the general concept were taken directly from the well known TS-940S transceiver, some other details are traceable to the older R-2000 and the already mentioned TS-440 transceiver. The design is well executed. Some novel ideas were realized, but there are also some shortcomings which become apparent very soon. These problems will be covered in detail later on.

Basically, this is a dual superhet, with a high 1st intermediate frequency of 58.1125 MHz. The 2nd IF is 8.83 MHz, a standard with Kenwood equipment. The antenna signal is channelled through several elaborate octave filters (1.8 to 30 MHz) or three low pass filters in the range below 1.8 MHz. A resistive pad, switchable from 0 dB to 30 dB attenuation, is part of the input circuit. Balanced mixers are used throughout, the AGC is amplified and fed to various stages and the signal strength indicator. The synthesized frequency of the local oscillator is controlled by a microprocessor via two phase locked loops. The excellent stability of the reference quartz oscillator shows in the displayed frequency resolution of 10 Hz. The first IF is filtered by a costly quartz lattice structure, mixed down to 8.83 MHz and subsequently processed in several user selectable circuits:

- IF shift (SSB only)
- various IF filters (most of them optional)
- 2 noise blankers with wide and narrow response and adjustable threshold
- tunable notch filter

Special attention was given to the audio section. Very careful component selection yields a neutral and immensely satisfying audio quality, even with the small built in

Kenwood R-5000

Manufacturer	Kenwood Corporation, Tokyo, Japan
Type of receiver	medium sized, stationary
Type of circuit	double superheterodyne, PLL synthesizer
Frequency coverage	100 kHz – 30 MHz, optional 118 – 174 MHz
Display accuracy	10 Hz
Frequency stability	+/– 12 Hz/hr
Remarks	Excellent communications receiver with above average SSB performance. 100 memories, numerous features. Has dual clocks and a timer function. Several interesting options are available. Very good audio qualities.

RF-section

	Frequency	Bandwidth wide	narrow	SSB
Sensitivity in µV for 26 dB				
S+N/N below 1.5 MHz	.15 MHz	21	19	–
Sensitivity in µV for 10 dB	1.00 MHz	14	12	–
S+N/N above 1.5 MHz	1.50 MHz	26	20	–
	2.00 MHz	1.7	1.5	.3
	3.00 MHz	1.5	1.3	.3
	5.00 MHz	1.5	1.4	.3
Modulation 400 Hz at 30%	7.00 MHz	1.5	1.3	.3
	10.00 MHz	1.5	1.3	.3
	20.00 MHz	1.5	1.4	.3
	30.00 MHz	1.6	1.4	.3

Bandwidth at –6/–60 dB	wide	normal	narrow
in +/– kHz	6.2/26	–	2.5/4.6

Image rejection	72 dB
AGC range	92 dB
ICP 3. order	+5 dBm
Dynamic range	92 dB
Tuning indicator	S1 1.5 µV
	midscale 22 µV
	end 25 mV
Antennas	none built in
Antenna connectors	one coax socket and two sets of clamps
Remarks	Has switch for antenna 1 / antenna 2. Input accommodates high and low impedance wires. Attenuator 0, 10, 20, 30 dB.

AF section

Audio power	1.4 watts at 10% THD
Audio frequency range	125 Hz – 6.7 kHz (+/– 3 dB points)
Tone control	none
Noise limiter	two separate circuits with adjustable level
Speaker	5", 8 ohms
Connections	earphones, record output, control for recording device, external speaker. Others see text.

General

Power supply	110/120 VAC or external 12 – 15 VDC, 1.8 A
Power consumption	approx. 42 VA (AC), 28 VA (DC)
Dimensions	28 × 11 × 31 WHD in centimeters
Weight	approx. 5.6 kg (12.3 lbs)
Accessories	manual, power cable, DIN connector
Price	List US$ 899.

FM Section

Range	118 – 174 MHz
Sensitivity	better than .7 µV/10 dB SINAD
Image ratio	better than 45 dB
Squelch sensitivity	.7 µV
Type of circuit	triple conversion
Filter	for narrow band FM signals only, see text

Note

FM demodulation can be selected throughout the entire tuning range.

speaker. One small feature deserves special mention. The set is equipped with two antenna inputs (antenna 1, antenna 2). Either input can be selected from the front panel. Switching is via special relays with very low RF leakage. Isolation between the two inputs is better than 60 dB. This is a very useful circuit which I'd like to see in several other good receivers.

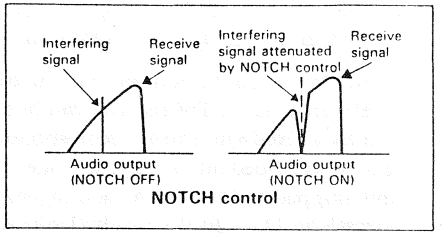
Two IF filters are built in, these are units with nominal values of 6 kHz/–6dB and 2.4 kHz/–6dB. Other filters can be selected as an option. These additions (or substitutions) are not exactly what I would call cheap. The large, multi-pole quartz filters are of almost commercial quality, with excellent long term stability and very close tolerances. Some experience and good soldering techniques are needed if you want to replace or add filters on the main circuit board. If in doubt have the dealer perform the modifications.

Kenwood offers several other options for this receiver:

- VC-20, VHF converter, range 108 - 174 MHz
- IC-10 and IF-232C, interface electronic package; allows computer control of most receiver functions
- VS-1, voice synthesizer, announces frequency through speaker; female voice
- DCK-2, DC power cable kit, for operation of the receiver from DC sources of 12 to 15 VDC. Approx. 1.8 amperes are required
- MB-430, mobile mounting bracket

These options can be added by the owner. Wire harnesses and connectors are already installed. The instructions are easy to understand.

In addition, some standard accessories are available: speakers, headphones, antennas, DC-supply, world time clock, etc.



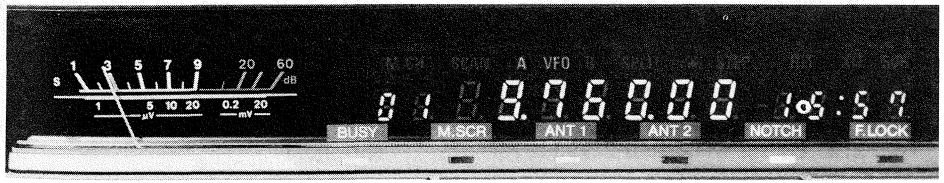
With the optional VHF board the receiver is turned into a triple superhet, with a third IF of 455 kHz. Only one narrow band FM filter (12 kHz/–6dB) is available. Some of the receiver's functions are disabled, e.g. notch filter and noise blanker.

The entire electronics are housed in a sturdy metal cabinet. This outer barrier and elaborate shielding of critical inside parts combine to form an RF-tight enclosure. Excellent workmanship is evident everywhere, the finish is outstanding. Appearancewise, the R-5000 exudes just the right "touch of class" and satisfying high-tech appeal.

The all-metal rear panel has connectors for

- an external speaker (8 ohms)
- antenna 1 (UHF coax socket)
- antenna 2 (two sets of clamps for high and low impedance wires)
- muting and control of a recording device. The timer activated relay can carry 30 VDC at about 1 ampere. It can be wired to provide either an open circuit or a closed circuit upon activation of the timer.
- serial input/output for the optional interface circuit

In addition, there are two cutouts which can be used to mount a separate UHF connector for the optional VHF converter,

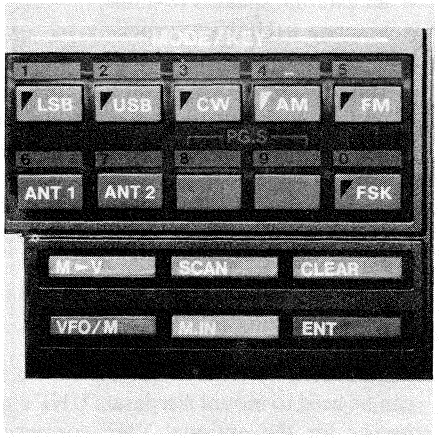


and/or the special 2-pin DC connector. The AC power cable can be removed.

A sturdy wire on the bottom can be used as an elevated stand. The receiver can be carried by a fixed vinyl strap, corresponding feet are provided on the opposite side. The unit shipped to the U.S.A. is designed to operate on 110/120 VAC only. Units sold elsewhere have a voltage selector switch with settings of 120, 220, and 240 VAC.

Buttons and functions

Basically, the R-5000 is a communications receiver with a frequency range from 100 kHz to 30 MHz plus the optional range from 118 to 174 MHz. All modes can be accommodated, with special circuits for CW and FSK (i.e. Frequency Shift Keying = RTTY = radio teletype). Upper and lower sideband demodulation modes can be selected independently, the SSB offset is programmed for straight reception of AM modulated broadcast signals in the SSB mode. No retuning is required, the excellent stability makes this mode of operation suitable for long term listening sessions.



On CW, the offset is programmed for an audio tone of 800 Hz. The notch filter is changed into a peak filter, but only if no special CW filters were installed. On FSK, the μP sets the frequencies for 170 Hz shift, with 2125 Hz for Mark and 2295 Hz for Space. This is the most widely used standard for ham and commercial traffic. Other shifts can be accommodated in the normal SSB mode.

Filter selection is automatic when the corresponding switch is set to AUTO. In this position, the controller switches a preprogrammed filter (see table) into the circuit. This selection can be overridden any time by repositioning the switch to another setting. Neither qualitative nor quantitative signal analysis is performed in the AUTO mode, the μP just switches according to a factory-set program.

The group of four concentric rotary controls in the right hand corner is used to

- adjust squelch level and notch filter frequency
- select the desired IF filter
- set noise blanker level and adjust the IF shift
- set audio and RF gain.

Noise blanker(s), notch filter and AGC (slow/fast) are enabled by separate buttons.

The fluorescent tube numeric display is easy to read, the brightness can be reduced with a pushbutton (DIM). Besides frequency (10 Hz resolution if desired) the following is shown:

- memory channel
- local time or world time (UTC), display can be switched off
- timer on/timer off settings (on request)
- various plain language prompts when programming the timer

In addition, several indicators are grouped in rows above and below this display:

- M.CH = memory read/write operation activated
- SCAN = scan in progress
- VFO A/B = manual tune with either VFO A or VFO B
- * = timer function activated
- STEP = tuning rate changed
- BUSY = signal is above squelch threshold
- M.SCR = memory review activated
- ANT 1, ANT 2 = selected antenna input
- NOTCH = notch filter activated
- F.LOCK = tuning knob and keyboard disabled

The large signal strength indicator is marked from S1 to S9 + 60 dB (!), in addition, there are calibrations for antenna input voltage. This scale proved to be amazingly correct. On the other hand, S9 does not correspond to the internationally agreed standard of 50 μV input.

Tuning can be performed either with the large tuning knob (electronically coupled) or via direct entry of the desired frequency. This latter function is hidden in the double row of mode selector buttons to the left of the tuning knob. This keyboard is rather difficult to operate. It is organized in a non-standard configuration, badly marked with low contrast numerals, and hard to reach for the majority of right-handers. Furthermore, the function of direct access tuning is overly complicated. One must push ENTER first, then punch

OPTIONAL FILTER COMBINATION	SELECTIVITY SWITCH POSITION	MODE KEY					
		USB	LSB	CW	FSK	AM	FM
N : None M1 : None	AUTO	2.4 kHz				6 kHz *	12 kHz
	N	2.4 kHz					
	M1						
	M2						
	W	6 kHz *					
N : None M1 : YK-88SN	AUTO	2.4 kHz		1.8 kHz		6 kHz *	12 kHz
	N	1.8 kHz					
	M1						
	M2	2.4 kHz					
	W	6 kHz *					
N : YK-88C M1 : None	AUTO	2.4 kHz		500 Hz		6 kHz *	12 kHz
	N	500 Hz					
	M1	2.4 kHz					
	M2						
	W	6 kHz *					
N : YK-88CN M1 : None	AUTO	2.4 kHz		270 Hz		6 kHz *	12 kHz
	N	270 Hz					
	M1	2.4 kHz					
	M2						
	W	6 kHz *					
N : YK-88C and M1 : YK-88SN	AUTO	2.4 kHz		500 Hz		6 kHz *	12 kHz
	N	500 Hz					
	M1	1.8 kHz					
	M2	2.4 kHz					
	W	6 kHz *					
N : YK-88CN and M1 : YK-88SN	AUTO	2.4 kHz		270 Hz		6 kHz *	12 kHz
	N	270 Hz					
	M1	1.8 kHz					
	M2	2.4 kHz					
	W	6 kHz *					
N : YK-88CN and M1 : YK-88C	AUTO	2.4 kHz		270 Hz		6 kHz *	12 kHz
	N	270 Hz					
	M1	500 Hz					
	M2	2.4 kHz					
	W	6 kHz *					

*: When the YK-88A-1 Crystal Filter is installed in the filter for W position, selectivity will not be changed, but the shape factor will be improved.

in the numbers including a leading 0 when below 10 MHz, and then tell the μP to tune to this frequency by hitting ENTER once more. There is an exception: The tuning commences automatically when seven digits were entered. I had hoped to gain some familiarity with this mad scheme, but even after eight weeks of daily use I find myself cursing at this thoughtless setup. Of course, if you've owned Kenwood equipment previously, this may seem a quite ordinary procedure. But, everybody else uses the well known calculator pad configuration for the keyboard, and not the awkward double row lineup.

Now, don't think this is a trivial complaint. If several frequency changes are necessary in short succession, every operator error adds just a tiny bit of irritation to a final state of displeasure. Of course, it's not an easy task to design a coherent and good looking front panel with a multitude of functions, but the engineers at Kenwood should have known better.

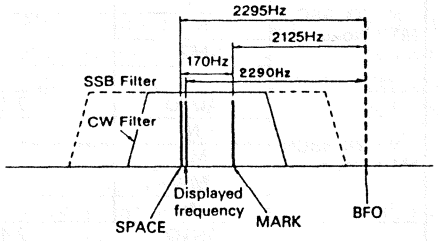
To add insult to injury, an audible mode announcement has been incorporated (or programmed) into the mode control CPU. Whenever a mode key is pressed, the first character of this mode's abbreviation is sounded in morse code through the speaker. (Exception: FSK, in this case R for RTTY is sounded). In addition, other beeping sounds are activated automatically:

- one short beep for most other keys
- one long beep for memory operations
- four short beeps for operator errors

This attention-getter (sic!) can not be defeated from the outside. One has to open the receiver and cut the signal carrying wire from the CPU to the audio section. Unfortunately, no schematic is provided with the receiver. The handbook is allright, covering most any aspect of operation with commendable clarity.

Manual tuning is quite easy, the tuning knob is finely balanced and of adequate size. The friction of this knob is adjustable between almost effortless spinning or moderate braking. The tuning steps look allright on paper, in practical use however the tuning rates are either too slow (AM mode, coarse tune) or too fast (SSB mode, fine tune).

The tuning knob and the associated electronics put data into either one of two temporary storage registers named VFO A and VFO B. VFO stands for Variable Frequency Oscillator. This feature is quite useful, e.g. when parallel frequencies are repeatedly checked for signal quality. The data in VFO A is retained when VFO B is activated, and vice versa. This VFO A/B switching is also very helpful when working a ham net with a single station slightly out of tune. Both VFOs can be equalized by pushing A = B. Of course, the data in VFO A and B are retained when memory operations are performed or the set is switched off temporarily. The backup battery lasts for about 10 days when the AC power cable is removed. Approximately six hours are needed to fully recharge the tiny NiCad accumulator.



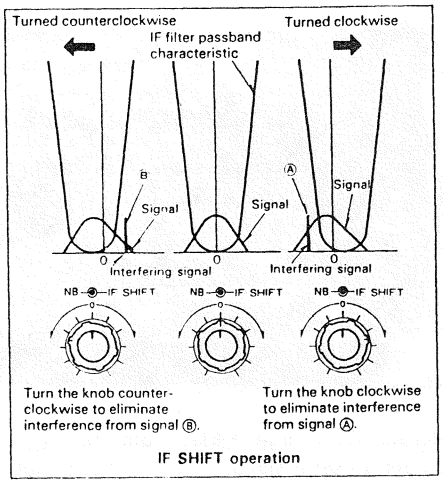
Frequency relationship

Tuning steps are selected automatically depending on whichever mode (AM, SSB) is activated. The tuning steps can be changed with the STEP key. See table.

The remaining buttons on the front panel are mostly self-explanatory:

- VOICE — activates synthesized frequency announcement
- TIMER — puts radio in timer mode
- DIM — reduces the display brightness
- CLOCK 1 — displays clock 1 time permanently
- CLOCK 2 — displays clock 2 time permanently
- OFF — blanks time display
- ON TIME — enables setting of timer
- OFF TIME — enables setting of timer
- TIME SET — sets programmed time into timer memory
- M→V — transfers frequency from memory to manual tune
- SCAN — initiates the scanning function (either within the memories or a programmed frequency range)
- CLEAR — cancels any keyboard operation
- VFO/M — switches between memory access and manual tuning
- M.IN — enters preset data into assigned memory location
- ENT — precedes or follows a direct frequency input
- UP/DOWN — increases or decreases frequency in steps of 1 MHz. Has auto-repeat function when held down. Can also be used to step memory channels either up or down when in memory access mode.
- HF/VHF — selects the optional VC-20 UHF-converter

The memory section is very flexible, the functions are easy to control and organized in comprehensive patterns. 100 memories for frequency, mode, and antenna selection (!) are provided. The contents of the memory are backed up by a rechargeable battery. The memory section is organized in banks from 00 - 09, 10 - 19, 20 - 29, etc. Memories x8 and x9 are special locations for an automatic tuning function within a programmed frequency range (AM and FM mode only!). On active frequencies, i.e. above squelch threshold, the scan (for auto-tuning) stops for about five seconds. A small modification changes this type of scanning to a carrier operated scan with a stop-on-signal function.



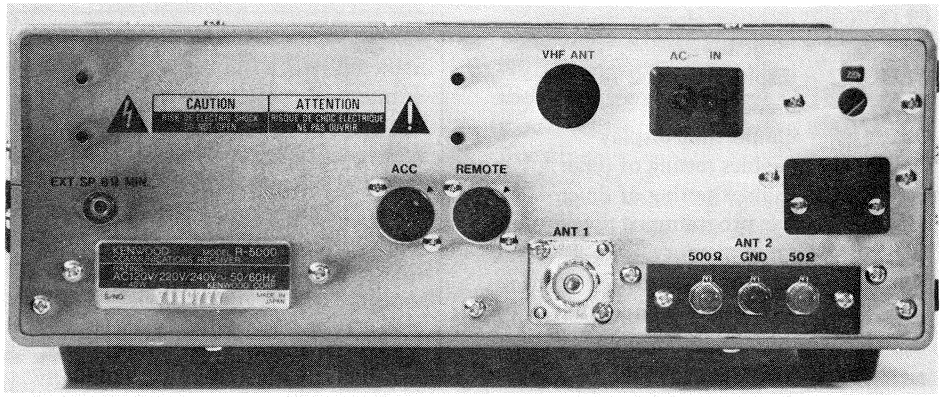
The connectors for headphones (low impedance) and a recording device are easily accessible on the front panel.

Needed: one good AM filter

The R-5000 comes with only two filters installed. These were measured at 6.2 kHz/ −6dB (wide) and 2.5 kHz/ −6dB (narrow). The wide filter has the unbelievable spread of 26 kHz at −60 dB, whereas the narrow filter measures an excellent 4.6 kHz at −60 dB. Other (better) filters are available as a costly option.

AM reception is alright as long as there are no stations in the vicinity of the desired frequency. If there is only one station on the next channel up or down, detuning one or two kHz to the free side is required to obtain clean audio. If you are lucky enough to find a station broadcasting on a free segment of the band, this wide filter immediately shows quite interesting properties. The audio is free of distortion (gently sloping skirt response) and the overall quality is truly excellent. This is partly due to the good matching of audio section and speaker.

The narrow filter can be switched into the circuit as an alternative. The resulting audio is simply unacceptable. One has to



detune about .6 to .8 kHz from the center to get a useful signal. The IF shift is not available in the AM mode of operation. This setup is barely adequate for amplitude modulated signals.

These are harsh comments, they could lead to a false impression about the overall quality of this receiver. All of the above mentioned shortcomings (or faults) can be corrected. Two measures are available:

1. Substitute the optional YK-88A-1 filter in the AM wide position (expensive), or
2. Tune to exact center and push either LSB or USB button.

The result of the latter measure is simply overwhelming. Suddenly it's all there: clean, crisp audio, excellent selectivity, minimum distortion. Since no retuning is necessary (not even when switching from USB to LSB) this method of reception is expressly recommended. What happens inside the receiver is fairly complicated, though. Only one sideband of the double sideband AM signal is used to extract the audio. The carrier is substituted by the internal (stable) oscillator. In addition, the narrow filter with its excellent characteristics is automatically switched into the circuit. Furthermore, IF shift and notch functions can now be used advantageously to combat any remaining interference problems. This tuning method can also compensate for certain propagation problems, e.g. selective fading and some flutter conditions.

True SSB demodulation is equally outstanding, so are all other modes, i.e. CW and FSK.

The measured data for the RF/IF section agrees with manufacturer's specifications. Don't be overly impressed by the + 14 dBm intercept point cited. This was measured with signals spaced 50 kHz apart and a very narrow filter. Our measurements are conducted with only 25 kHz spacing, and now the figures look somewhat different: ICP 3rd order of + 5 dBm and a dynamic range of 92 dB. Not bad at all, there are very few consumer-grade receivers with better specifications.

In a side-by-side comparison with Japan Radio's NRD-525 the R-5000 did quite nicely. As a matter of fact, in the SSB mode of operation the Kenwood pulled in every signal as clean and easy as the more expensive competitor.

There are very few spurious signals. Cross- and intermodulation effects can be produced only by a laboratory setup. In practical use these distortions do not appear. Rejection of image frequencies is excellent. Only the AGC time constants are somewhat on the fast side.

The IF shift has a range of + / – 1.1 kHz, more than enough to combat various kinds of interference close to the desired frequency (narrow filter should be used in this case).

The notch frequency can be adjusted from 200 Hz to about 2.5 kHz. The notch is rather narrow, the control should be turned very slowly. Attenuation of single narrow band signals is better than 28 dB throughout the tuning range. In the AM mode, the notch filter sometimes works effectively as a dynamic noise filter. Background hiss can be reduced by about 6 dB. This has to be tried out and may not work all the time.

Certain combinations of RF gain setting and AGC timing can dramatically improve signal quality. As a rule, use the attenuator to keep the signal strength indicator slightly above S9 + 10 dB whenever very strong signals are received. Clean reception is indeed possible with signals pegging the needle of the meter at S9 + 60 dB, a clear indication of the excellent construction of the RF/IF section.

Frequency Step

Mode / STEP key	AM		USB/LSB/ CW/FSK		FM	
	OFF	ON	OFF	ON	OFF	ON
Frequency step	1kHz	100Hz	10Hz	100Hz	5kHz	2.5kHz
One revolution of TUNING knob	20kHz	50kHz	10kHz	50kHz	100kHz	50kHz

Sensitivity is reduced in the range below 1.8 MHz. This has no negative effects on the ability to receive weak signals. The amount of background noise (man-made and natural) is quite high in this lower part of the frequency spectrum.

The set tested showed some susceptibility to spikes and transients from the mains supply. On occasion, the audio is muted completely by the AGC circuit.

When compared with Icom's IC-R71A (stock version), it took several hours to determine a slight superiority of the Kenwood receiver. RF and IF sections of these receivers are about equal, but the R-5000 has the better audio and this seems an important consideration.

The substitute YK-88A-1 AM filter has a response of 6 kHz/11 kHz at – 6/ – 60 dB (excellent filter factor!), it will provide some additional improvement and is recommended if programme listening is planned. Other optional filters are necessary only if extensive SSB work is to be done. The filter table should be studied very carefully.

All in all, the R-5000 is a capable performer when used in the SSB mode. On AM, some limitations are evident. These are only due to inadequate filters, the receiving section itself is of remarkable quality. The multitude of functions puts the R-5000 almost in a class by itself. Undoubtedly, this is the best receiver ever offered by Kenwood.

LOWE HF-125

Manufacturer	Lowe Electronics Ltd., Matlock, Derbyshire, UK
Type of receiver	small stationary, optional portable package
Type of circuit	double superheterodyne, PLL synthesizer
Frequency coverage	30 kHz – 30 MHz
Display accuracy	1 kHz
Frequency stability	+/–22 Hz/hr.
Remarks	Interesting communications receiver with above average performance. 30 memories, numerous hidden features. Several filters are built-in. Decent audio, very good dynamic range. Synchrophase detector and other options are available. Looks ugly, performs nicely.

RF-section

	Frequency	Bandwidth wide	narrow	SSB
Sensitivity in µV for 26 dB				
S+N/N below 1.5 MHz	.15 MHz	18	16	–
Sensitivity in µV for 10 dB	1.00 MHz	14	11	–
S+N/N above 1.5 MHz	1.50 MHz	11	10	–
	2.00 MHz	1.3	1.1	.3
	3.00 MHz	1.3	1.1	.3
	5.00 MHz	1.5	1.4	.3
Modulation 400 Hz at 30%	7.00 MHz	1.2	1.1	.3
	10.00 MHz	1.3	1.2	.3
	20.00 MHz	1.4	1.3	.4
	30.00 MHz	1.6	1.4	.4

Bandwidth at –6/–60 dB	wide	normal	narrow
in +/– kHz	10.3/34	5.6/10	2.7/4.5

7 kHz filter was measured at 8.1/13.5 kHz

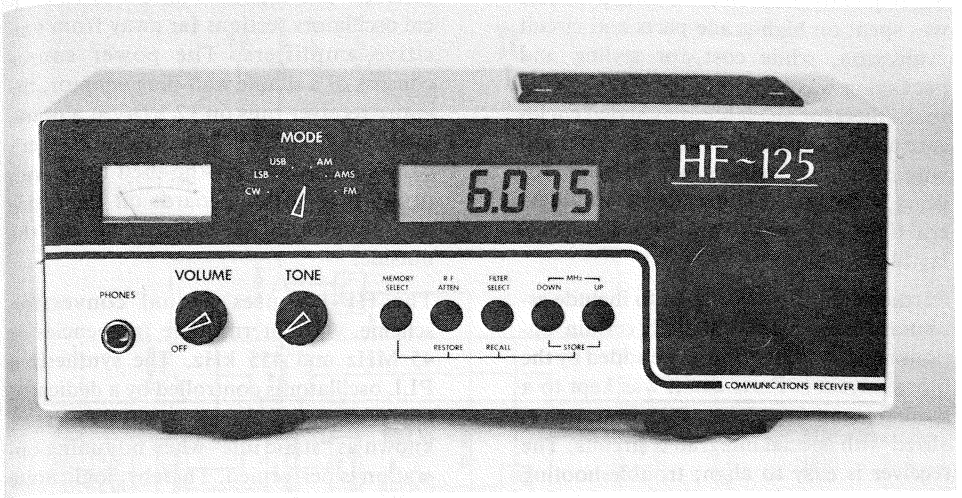
Image rejection	82 dB
AGC range	86 dB
ICP 3. order	+2 dBm
Dynamic range	84 dB at 20 kHz signal spacing
	72 dB at 10 kHz signal spacing
Tuning indicator	S1 1.2 µV
	midscale 48 µV
	end 49 mV
Antennas	none built in
Antenna connectors	one coax socket (50 ohms) and one set of clamps
Remarks	Optional active antenna available
	Attenuator 20 dB

AF section

Audio power	1.2 watts at 10% THD
Audio frequency range	125 Hz – 8.7 kHz (+/–3 dB points)
Tone control	single
Noise limiter	permanently in-circuit, non-adjustable
Speaker	3.5", 4 ohms
Connections	headphones, record output, external speaker. Others see text.

General

Power supply	12 VDC at approx. 250 mA
Power consumption	approx. 1.8 VA
Dimensions	25.5 × 10 × 20 WHD in centimeters
Weight	approx. 1.8 kg (3.7 lbs)
Accessories	manual, power supply schematics
Options:	NiCad pack plus active antenna
	NBFM plus Synch-Detector
	Keypad for direct frequency input
	external matching speaker
	Technical Manual



Lowe HF-125

An interesting receiver was introduced early in 1987 by the British company Lowe Electronics. The new HF-125 has just the right touch of awkward appearance to generate the ever-popular question: Does it perform as bad as it looks?

Made in the United Kingdom

Lowe is well known as the supplier of various general purpose radios and other electronic niceties. The company offered some low-priced shortwave receivers of Japanese origin a while back. These were the XCR-30 Wadley-Loop design and the digitalized version XCR-30D. The radios were also sold under various other names, e.g. Century 21.

The idea of producing a better, home-made shortwave receiver was conceived several years ago by John Wilson, Technical Director of this company. It took some years to finally realize this concept. Most of the circuits for the new HF-125 were drawn by John Thorpe, Head of Development since 1982.

The final plans were agreed upon in January 1986. Of course, most of the details had been worked out by then, but it still is a remarkable feat to get a production line started in only one year. The HF-125 is assembled in the UK, using standard parts and a simple run-of-the-mill aluminum cabinet. A daring venture, considering the situation. There are quite some competitive designs from Japanese manufacturers, offering more spectacular packaging and a multitude of novel features.

A different approach

The primary goal was to build a receiver with above average performance at a very competitive price. Special attention was given to the design of the front end and its large signal handling capability. This feature is a must for receivers to be used in Europe, where an exceptional number of high powered shortwave transmitters are located.

Subsequently, most of the money available was spent on high-grade parts and circuit evaluation, while cost for styling and packaging was kept very low. The special tools (dies) for an elaborately styled enclosure are very expensive. This is one reason why certain receivers are around for years, – the manufacturer has to build several thousand units to get even on the outlay for tooling.

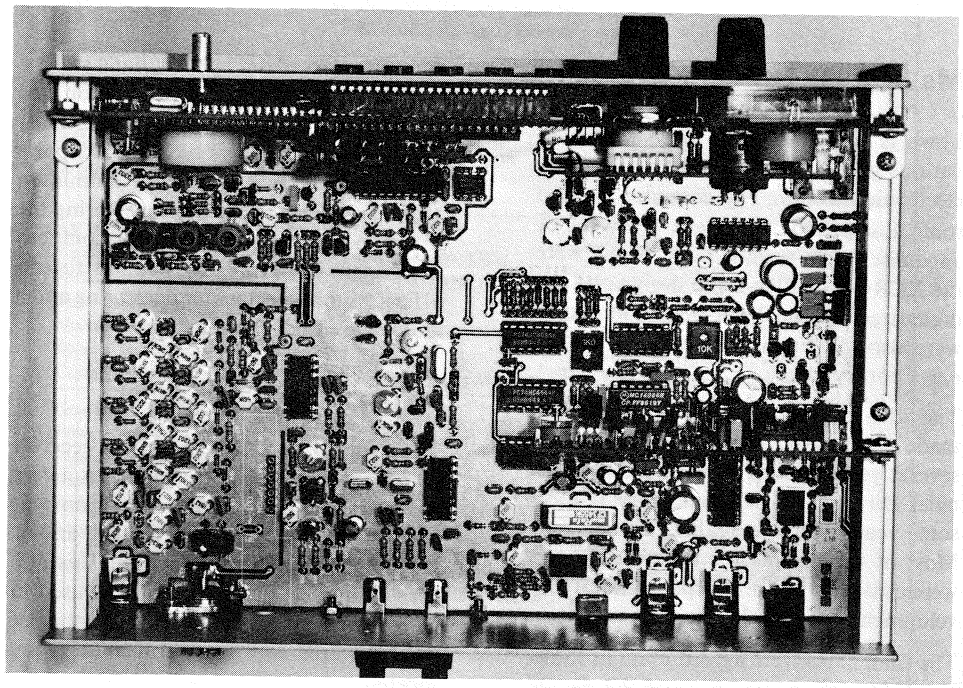
Furthermore, Lowe decided to include essential features only, though certain options are offered which can be added by the buyer anytime. Parts count was kept to a minimum, most receiver functions are realized with special integrated circuits. The receiver is easy to align; troubleshooting and repair are augmented by a built-in test feature.

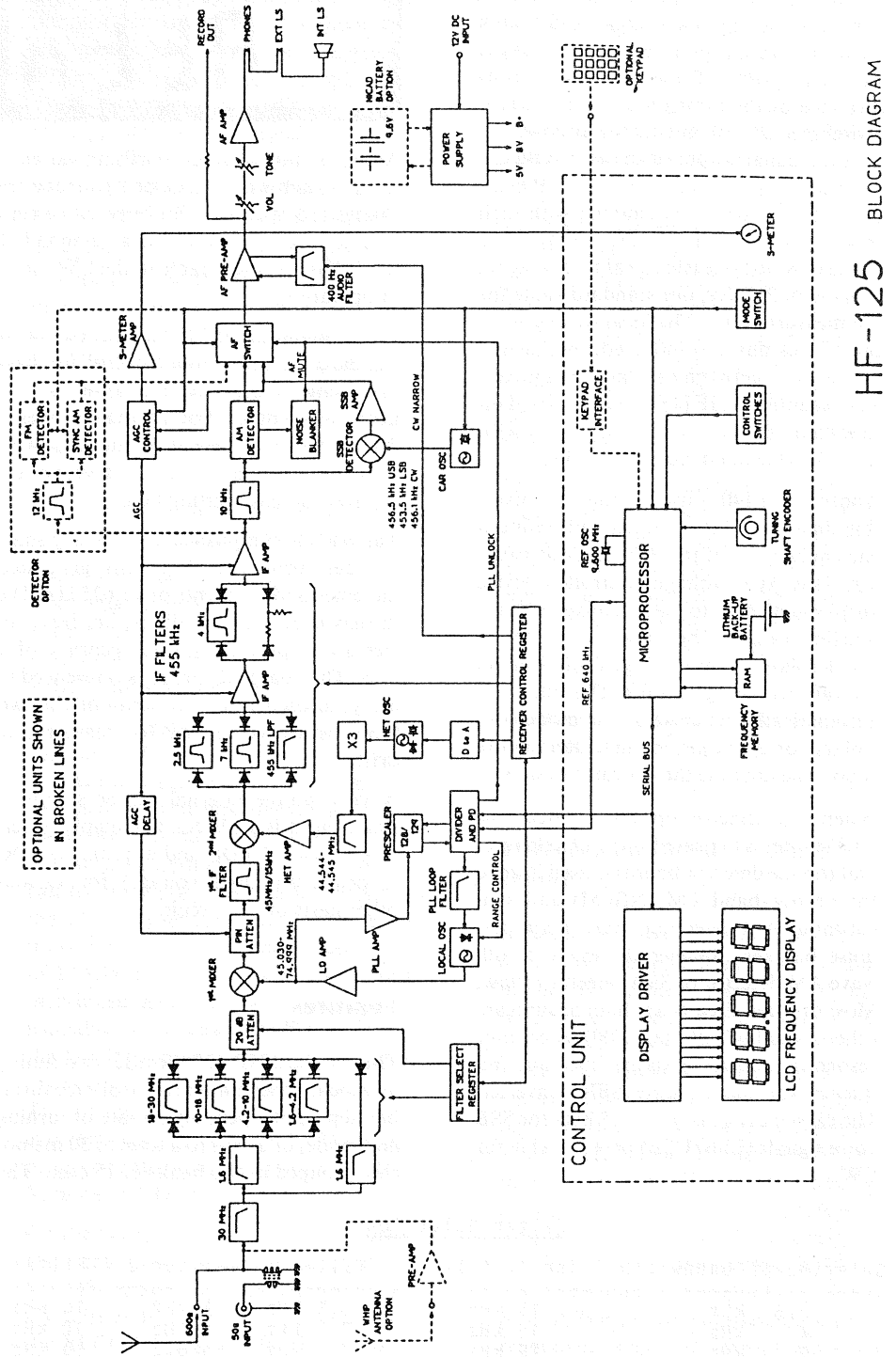
The logical result is a homely looking box with very few controls, a minimum of features (or gimmicks), and maximum performance within the given price bracket. There are no shielded compartments on the circuit board, otherwise a familiar sight in most any medium grade shortwave receiver. The engineers have located critical oscillators sections far away from sensitive amplifiers. The power source consists of a simple wall-plug adaptor, the entire receiver runs on 12 VDC at a nominal consumption of 250 mA. The receiver's case is a standard off-the-shelf item, with neatly fitted circuit boards on the inside and reasonably clean lettering on the outside.

The HF-125 uses a dual conversion scheme, with intermediate frequencies of 45 MHz and 455 kHz. The synthesized PLL oscillator is controlled by a dedicated microprocessor. This μP is put into a state known as "static idle" when no tuning operation is performed. Thereby, logic noise (spikes) is reduced substantially. Incidentally, Sony's ICF-2010 uses the same technique.

Details

The antenna signal is coupled inductively (50 ohm input only) to the input section, comprising a 30 MHz low-pass filter (– 6





dB at 32.8 MHz), a diplexer with 1.6 MHz low-pass and high-pass filters, and a bank of four octave-type filters for the ranges above 1.6 MHz. These filters are diode-switched by the tuning logic. An operator switchable 20 dB attenuator follows before the signal is applied to the first mixer. A complex integrated circuit from Plessey (SL6440) is used here, running with high mixer current. This insures a dynamic range of 84 dB (measured value) at a signal spacing of 25 kHz, our standard value for lab measurements. The local oscillator input to this mixer is buffered, minimizing interactions between oscillator and mixer. The resulting 1st IF (45 MHz) is passed on to a high-quality 4-pole crystal filter with +/−15 kHz bandwidth at −6 dB.

Another SL6440 is used in the 2nd mixer, this time the IC is operated with reduced current because of the PIN-diode attenuator. This AGC voltage controlled device keeps signal input to the 2nd mixer within a sensible range. The filter arrangement which follows is interesting. Table 1 shows the various configurations. The filters are automatically switched by the mode control section of the μP, manual intervention is possible anytime the operator desires.

When the detector option is fitted, the 10kHz filter is bypassed and a 12 kHz filter unit (on the detector board) is used instead for narrow-band FM (NBFM) and synchronous AM detection. AGC amplifier, noise blanker, S-meter driver, and full-wave AM detector or SSB detector follow. Most of these circuits are built around another special IC (Plessey 6700). A ceramic resonator ensures a stable injection frequency for the separate SSB converter. The carrier offset is +/−1.5 kHz for SSB voice signals (LSB/USB) or +1.1 kHz for CW.

Audio is muted momentarily in an electronic switch when mode or frequency are changed. A special audio filter with a center frequency of 800 Hz and a passband of +/−200 Hz is selectable in the CW mode of operation.

The remainder of the audio circuit is standard. A single tone control for bass and treble is used. Audio power is 1.25 watts into 4 ohms, the internal speaker is driven with somewhat reduced power. This is more than enough for a shortwave receiver, no cost-cutting here.

Tuning is accomplished via a rotary shaft encoder, producing internally generated increments/decrements of 15.625 Hz. The display uses only five digits, i.e. frequencies are displayed with an accuracy of 1 kHz. The dual PLL circuit is referenced to a crystal oscillator. The setup of the two loops is self-correcting for temperature drift.

A very simple internal power supply is used. Input is 12 VDC, the supply generates 5 VDC, 8 VDC and approx. 10 VDC (depends on input voltage) for various other parts of the circuit.

Features

The standard HF-125 provides two tuning methods: either manual control with variable step size (depending on rate of turning and mode) or access to a total of 30 memories, grouped in two banks of 15 each. The contents of memory can be reviewed while the receiver is operated, without interfering with the presently set frequency. A direct access tuning pad is an optional extra. The memory is backed up by a lithium battery, having an alleged life-span of more than five years. Large changes in frequency (1 MHz up or down) are possible with two pushbuttons on the front panel.

Most operational settings are switched automatically, e.g. the response of the automatic gain control (AGC) is changed according to the mode in use. Frequencies are displayed on a large liquid crystal display (LCD). The small signal strength indicator and the LCD are faintly illuminated, the scale of the S-meter ends at S9+50 dB (!).

The display segments are used to report various other functions or settings:

- memory mode on/off
- attenuator on/off
- filter selected
- contents of memory
- BITE information (see below)

Normal operation, i.e. tuning, volume control, and filter selection is as straightforward and simple as can be. The set is switched on by turning the volume control clockwise. Five buttons below the LCD are used to store frequencies into memory, recall from memory, change filters, actuate the 20 dB attenuator and perform up/down stepping in increments/decrements of 1 MHz. In addition to the 30 memories mentioned, a temporary storage register is available. This "scratchpad" can e.g. hold the last frequency used before a memory channel was called. A quite useful feature. The tuning knob is coupled to a rotary encoder with 200 steps of 15.625 Hz. And of course, there are the two controls for Volume and Tone.

On the back, antenna inputs are provided for either low impedance (coaxial jack SO-239) or high impedance (clamps) aerials. The audio output can be taken from the RECORD jack at a fixed level for external processing/recording or from the EXT LS jack to drive an outboard speaker. When the optional FM/AM Synch board is fitted, a small potentiometer is accessible to set FM squelch level. The small connector with the legend KEYPAD is used in conjunction with the optional direct input pad.

A bottom-mounted wire frame provides (excessive) elevation of the front panel. The set comes with an external power supply, a manual, and schematics. That's about it, no unnecessary features, no multi-coloured displays, no multiple and sometimes confusing switching arrangements. Talking about manuals, – this 24-page booklet is one of the best guides I've seen in years.

Of course, cost-cutting is evident everywhere. At first glance, one is very reluctant to spend several hundred bucks for this funny looking contraption. But, the circuit boards are adequately packaged, the case itself makes a sturdy impression and the circuitry is state-of-the-art in all areas where this is necessary.

Question remains, how does this receiver perform?

Different approach, same result

It may be hard to believe, but the HF-125 is as capable as any $500.-receiver I've had in my hands. Needless to say, it took sometime to get used to this concept of minimum controls. As a matter of fact, after a week or so I liked it, and on my daily listening sessions I found myself using this ugly duckling with a distinct preference. The HF-125 is indeed exceptionally simple to operate, without compromising performance. Well, the two small rotary controls for Volume and Tone could be a tad larger, their mechanical stability is also something I would like to see improved.The plastic laminate covering the front panel is not fully transparent where it should be, the S-meter is extremely hard to

Filter Selection

Selected IF bandwidth	1st IF filter	Filter 1	Filter 2	Filter 3
2.5 kHz	15 kHz	2.5 kHz	4 kHz	10 kHz
4 kHz	15 kHz	7 kHz	4 kHz	10 kHz
7 kHz	15 kHz	7 kHz	Through	10 kHz
10 kHz	15 kHz	500 kHz	Through	10 kHz

Tuning Rate
(Frequency range covered per revolution)

Mode	Slow tuning rate	Fast tuning rate
CW, LSB, USB	3.125 kHz	50 kHz
AM	12.500 kHz	100 kHz
AM Synch	3.125 kHz	3.125 kHz
FM	25.000 kHz	200 kHz

read. In addition, the lettering of the meter's scale is simply too small.

Otherwise, I'm quite willing to agree to this "no-frills" idea. The radio does everything one expects, – and then some. The HF-125 covers the range from 30 KHz to 30 MHz without gaps. The extreme low end of this frequency range is quite useful. Here in Germany we have a time-signal station at 77.5 kHz, with a 24 hour signal. This could be received clearly and without distortion, as subsequent processing in a minicomputer showed.

The longwave band (popular here in Europe) brought the usual crop of broadcast signals from bordering countries. A directional loop was used for tests on medium wave (BCB). Here the HF-125 performed quite admirably, with good sensitivity, excellent selectivity and no overloading problems.

Audio quality is adequate, a marked improvement is possible by connecting an external speaker having better fidelity. The synchrophase detector could be used advantageously, though correct tuning proved to be somewhat tricky.

On shortwave (AM-mode) the receiver consistently showed outstanding sensitivity and good dynamic properties. Sony's ICF-2010 was easily outperformed on AM and SSB. The synchrophase detector in the HF-125 is just a bit better, too. Unfortunately, the designers didn't include a "LOCK" indicator. The unit tested had no FM circuit, narrow band FM, that is. Lowe informed me, that this part of the optional FM/SYNCH board is undergoing some re-design and will be substantially improved in production models.

The ceramic filters (Murata CFJ 455K5, CFW 455 HT, CFW 455IT, CFU 455G2) are adequate. They performed to specifications and can handle almost any situation. If they are not good enough, put in your own. The 2nd intermediate frequency is 455 kHz, there are literally dozens of different filters available for this frequency.

The filters are initially selected as follows:

- AM : 7 kHz
- SSB : 2.5 kHz
- CW : 2.5 kHz plus 400 Hz filter centered on 800 Hz
- FM : 12 kHz (fixed, no alternative possible)

Whenever the filter selection button is pushed, the present filter setting is spelled out on the display. Another push selects the next filter according to the sequence 2.5 – 4 – 7 – 10, and back to 2.5.

There are numerous weak spurious signals, these could present a problem when doing serious SSB-DX. The small tuning steps are inaudible, the receiver tunes nicely in the SSB-mode, with just the right "gearing". Audio in this mode is crisp and clean, the typical sound of a communications receiver.

The dynamic properties of the HF-125 are without criticism, substantially better values are not possible in this price bracket. ICP 3rd was determined at +6 dBm (output of 1. mixer, signals at +/–25 kHz). At a spacing of +/–10 kHz dynamic range dropped to 79 dB.

Tuning is very easy, the various steps are programmed sensibly (see Table 2). The large tuning knob has no flywheel characteristics, this is another item one has to get used to.

ECSS tuning (exalted carrier, selectable sideband) works fine, though it takes some experience and a sensitive ear to tune to "carrier zero", – the display shows only increments/decrements of 1 kHz. The synchronous AM detector utilizes a narrow deviation, phase locked oscillator to replace the original AM carrier signal. Carrier fades do not degrade the detection process as long as there is some carrier for the oscillator to lock on. The improvement in audio quality can be dramatic. This is another reason why I'd recommend the use of an external speaker.

One really has to do some side-by-side comparisons before passing final judgement on this funny looking design. The HF-125 is a serious piece of equipment, don't be deceived by the unassuming front panel and the lack of spectacular features. The HF-125 will outperform most competitors. If you like an honest approach to receiver design, this is it: British Understatement at it's best.

Automatic testing

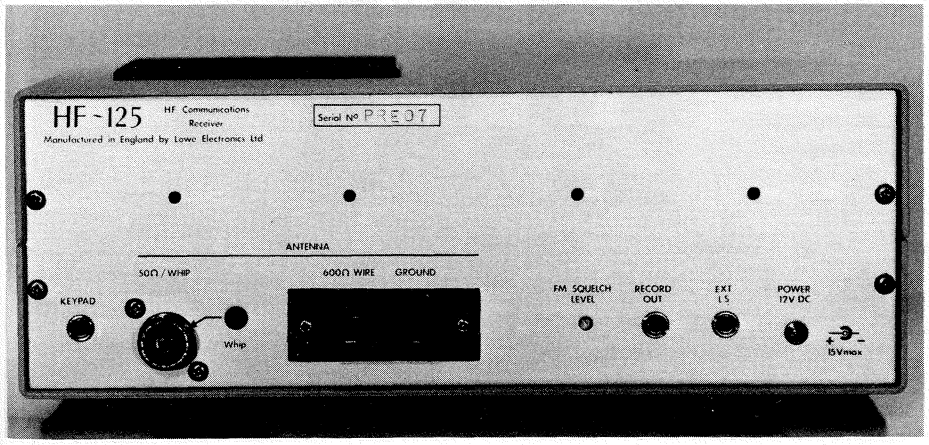
BITE means Built-In Test Equipment. A certain part of the microprocessor's "intelligence" is used to run tests on the control section of this receiver. This function comes in very handy when a malfunction is to be located or alignment must be performed. There are five test routines available, these are selected by specific settings of the receiver's controls. The display shows up to four error codes, indicating the defective section. The Technical Manual (obtainable at extra cost) is needed to run and evaluate the tests. The purchase of this manual is recommended. It contains an indepth description of circuit functions, alignment procedures, and detailed, large scale diagrams.

Options

Several times certain options were mentioned. Here are the details:

1. Portable option
A package with a NiCad battery and a charging circuit, a whip antenna and a small pre-amplifier board for this antenna. In effect, this is an active electronic antenna. The radio will run approx. 8 hours on a fully charged battery.

2. Keyboard option
An external keypad (telephone style) with a serial 2-wire interface is connected to a corresponding circuit inside the receiver. This keyboard is used for direct access tun-



ing. Quite possibly, the serial interface can be used to control the frequency with a personal computer.

3. Detector option

Another internally fitted board with two functions:

- synchronous AM detection and
- narrow band FM detection.

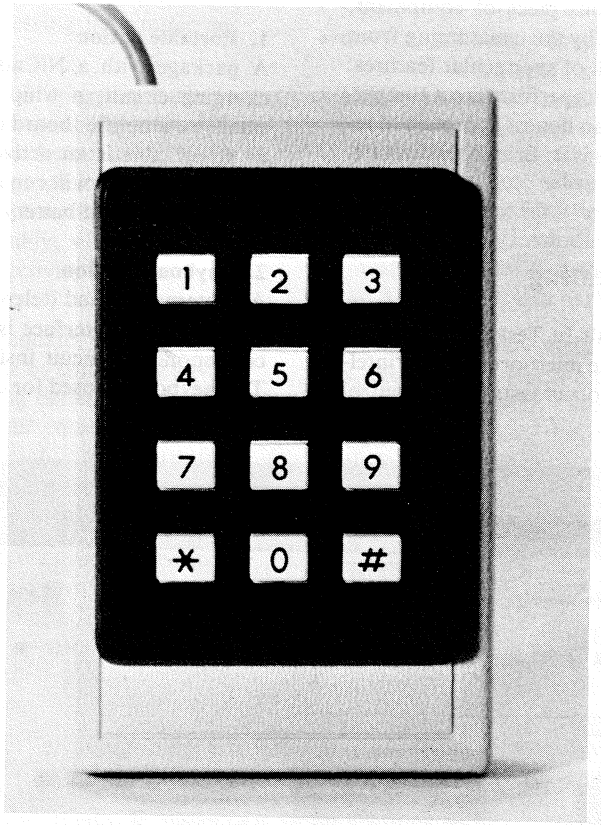
The synchronous AM detector can be used to compensate for certain propagation problems, e.g. carrier fade or selective sideband fade. In effect, only one sideband of the dual-sideband AM signal is demodulated. This gives an additional measure of useful selectivity.

The narrow band FM detector is designed to recover intelligence from FM modulated amateur radio signals. Don't confuse this NBFM mode with FM radio reception.

Remarks

The dynamic range of the HF-125 varies with power supply voltage. Best values on the unit tested were obtained at 15.2 VDC input. This is due to the mixer current being a function of input (non-regulated) voltage. Now, don't use input voltages in excess of 16 VDC, this could damage the receiver permanently.

Fully equipped with all options, the HF-125 is a very nice portable. Unfortunately, no handle or carrying strap is provided. With some ingenuity, a proper handle can be fitted to the metal case.



Panasonic RF-B600

Manufacturer	Matsushita Electric Trading Co., Japan
Type of receiver	oversized portable
Type of circuit	double superheterodyne, PLL synthesizer
Frequency coverage	LW, MW, FM, SW 1.6 to 30 MHz
Display accuracy	100 Hz
Frequency stability	+/− 85 Hz/hr
Remarks	Contemporary design, sleek looking receiver. Digital display, nine memories, direct access frequency input. Automatic search (SW only) and memory scanning. Portable, can be powered by mains or batteries.

RF-section

	Frequency	Bandwidth wide	narrow	SSB
Sensitivity in µV for 26 dB	.15 MHz	28	24	–
S+N/N below 2 MHz	.50 MHz	26	24	–
Sensitivity in µV for 10 dB	1.00 MHz	26	23	–
S+N/N above 2 MHz	1.50 MHz	22	19	–
	2.00 MHz	1.9	1.6	1.1
Modulation 400 Hz at 30%	3.00 MHz	1.7	1.5	.9
	5.00 MHz	1.7	1.5	.8
	7.00 MHz	1.7	1.3	.7
	10.00 MHz	1.9	1.4	.7
	20.00 MHz	1.6	1.3	.7
	30.00 MHz	1.8	1.3	.8

Bandwidth at −6/−60 dB	SSB	normal	narrow
in +/− kHz	2.6/5.8	4.4/12.1	2.6/5.8

Image rejection	42 dB
AGC range	80 dB
ICP 3. order	−12 dBm
Dynamic range	81 dB
Tuning indicator	S1 3 µV
	midscale 24 µV
	end 15 mV
Antennas	telescope 105 cm, ferrite rod
Antenna connectors	UHF type coax, plus separate clamps (AM and F for high impedance antennas)
Remarks	Antenna input may be switched from wire to coax input. External antenna for LW/MW couples into ferrite rod.

AF section

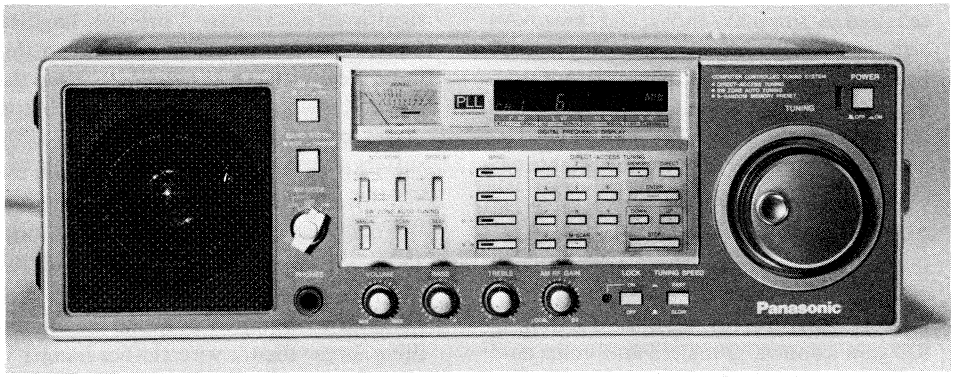
Audio power	1.6 watts at 10% THD (mains)
Audio frequency range	82 Hz – 8.5 kHz (+/−3 dB points)
Tone control	separate for bass and treble, +/−8 dB each
Noise limiter	yes, marginally effective
Speaker	4", 8 ohms
Connections	external speaker, earphone, record

General

Power supply	110 or 220 VAC, or 10 to 15 VDC
Power consumption	AC 16 VA, DC 7 VA
Dimensions	36 × 12 × 25 WHD in centimeters
Weight	approx. 4.7 kg (10.3 lbs) with batteries
Accessories	manual, frequency list, SWL primer
Price	approx. US$ 400.-

Miscellaneous

FM sensitivity	1.4 µV for 20 dB SINAD
Spurious signals	65 dB below wanted signal (worst case)
Accuracy of clock	+4 seconds/month



Panasonic RF-B600

The outmoded DR-48 and DR-49 were replaced by this modern looking receiver in 1985. Obviously, the engineers were in a hurry to market a competitive product; the RF-B600 is not all it should be.

All modern conveniences

This new development is a fresh approach to receiver design by this large Japanese company. The front panel is clearly divided into functional areas, all knobs and buttons are clearly marked with their respective function(s). The radio receives FM, LW, MW (BCB), and SW from 1.611 to 29.9999 MHz. Traditionally, Matsushita includes the FM range in their larger communications receivers.

The ranges are selected by the prominent pushbuttons in the center of the front panel. A tiny LED is part of each button, it will light up to show which range is activated. The RF-B600 utilizes latest techniques, this is a µP controlled double superhet with a synthesized oscillator and phase-locked-loop frequency control. Frequency resolution and display are 100 Hz or 1 kHz on LW, MW, SW, and 50 kHz or 100 kHz on FM. Several methods can be used to set the desired frequency:

- manual tune with the large tuning knob
- direct keyboard input (1 kHz resolution)
- memory recall (one of nine memories)
- step tuning (5 kHz up or down)
- automatic search (SW only)
- automatic scanning of memories (3 seconds interval)

The automatic search can be set to either stop on signals above S=3, or to pause momentarily and continue after three seconds. These automatic functions are limited to a range of +/−150 kHz around the starting point.

Frequency and memory channel are shown on a fluorescent display tube. The bright blue display is easy to read. The set can be operated with batteries, therefore a button (DISPLAY) is included to switch off the display and the illumination for the signal strength indicator. In addition, a battery check function helps to determine the condition of the batteries. A mains supply is built-in, in some versions the mains input voltage may be set to either 110 or 220 VAC. The line cord is detachable. Two sets of batteries are needed for mains-free operation. The compartments are located in the bottom of the cabinet. Eight D cells are

required to power the radio, and three AA cells are needed at all times to provide back-up power for the memory. A fold-out stand is provided to elevate the receiver's front by about 2″. This feature is very helpful when the set is placed on a table or desk top.

The RF-B600 has most of the standard features one expects to find in a modern receiver: bandwidth switching, noise blanker, separate AM, USB, LSB settings, RF gain control, S-meter, and coax antenna input. The built-in telescope antenna can be switched off. Furthermore, there are clamps for an external FM aerial. High impedance (wire) antennas for LW, MW, SW may be connected to an extra set of clamps.

There are outputs for an external speaker and tape recording. Unfortunately, the designers didn't see the need to include a clock-timer function. There also is a muting input which disables (protects) the receiver's front end when it is used in conjunction with a transmitter. Last not least, a DC input jack is provided to power the receiver from a source of between 11 and 15 VDC.

A carrying handle on the right side and rubber feet on the opposite side were thoughtfully included. After all, this receiver weighs 4.7 kg (10.35 lbs) and you'll want to rest occasionally when you take this radio for a walk.

A world map with time zone markings is imprinted on the top lid, and there also is a table of radio and ham bands. Alas, both are not up to date. The new 22m band is not included, and the time is still given in GMT.

The RF-B600 comes with a comprehensive manual, a 50 page frequency list, and a short primer on shortwave reception and antenna construction.

New, but not better

When compared to other radios within this price range, the RF-B600 could not gain a significant advantage. A properly handled Sony ICF-2010 is vastly superior to this large receiver (shortwave only!). Even the small Kenwood R-600 performed better under critical conditions. The RF-B600 suffers from several ailments which are tell-tale signs of fast and hurried development.

There are numerous whistles and birdies from the internal synthesizer, and a pronounced tendency to overload when anything larger than a wire clothes-hanger is connected to the external antenna inputs. Sensitivity is high and the use of some outboard signal attenuator is mandatory. A simple matchbox will not alleviate this problem. The wide AM filter is next to useless if there is a station within +/−15 kHz of where you have tuned. The narrow filter is adequate, but it causes annoying harmonic distortions in the audio output. Depending on your personal preferences, audio can be judged as being either fine or just mediocre. Fortunately, the separate controls for bass and treble have sufficient range to compensate the bass-heavy sound.

Besides these shortcomings, there is also an uncanny amount of images which simply should not be there in a double superhet with a 1st IF of 40 MHz. Last not least, the set used for testing was very susceptible to mains interference of any kind.

Despite these shortcomings, the RF-B600 can be used for shortwave listening if your demands are reasonable. The price is interesting and reception qualities are quite acceptable when only the built in antennas are used. Operation is simple and straightforward, but again, read your instructions. There are some unusual features, e.g. the way to input SW frequencies. Either kHz or MHz formats may be used, one just has to enter the decimal point when inputting MHz. On FM, the logic (logic?) requires a full input, e.g. 104.3 or 104.35 (MHz). On all AM ranges, keyboard inputs are limited to kHz, no further input is accepted. The 100 Hz resolution is available only with manual tuning.

SSB voice (A3J) reception is surprisingly good. Of course, this is not a communications type receiver, but I was duly impressed by the clear and distinct audio. Single sideband reception of AM signals is quite possible. Some correction of the internal reference oscillator may be needed to eliminate beats. After all, the smallest tuning step is 100 Hz.

Summary

The Panasonic RF-B600 has below average performance on SW, but does quite nicely on all other ranges. An unusually complete array of controls plus a clear and under all conditions readable frequency display with 100 Hz resolution are packaged in a contemporary looking enclosure.

The adaptability to various power sources, the built-in antennas, and the up-to-date operating concept with direct-access frequency selection are arguments to be considered. This receiver is quite suited for the beginner or shortwave listener, although the limitation to only nine memories is a shortcoming when one wants easy access to favourite stations. When external antennas are used, a matchbox plus variable attenuator is recommended. If set up correctly, the external antenna can improve performance substantially, especially when weak SSB signals are of special interest. This does not imply a recommendation for all-out DXing. The spectrum of performance of this receiver is clearly limited to program listening on SW. The other ranges (LW, MW) are somewhat better than average. Best section is the FM band, which has adequate sensitivity, good selectivity and decent sound.

Panasonic RF-B60/L

Manufacturer	Matsushita Electric Trading Co.; Ltd., Japan
Type of receiver	small portable
Type of circuit	double conversion, PLL synthesizer
Frequency coverage	1.615 – 30 MHz, plus LCD, HCD, FM
Display accuracy	1 kHz on SW, FM 50 kHz
Frequency stability	better than +/– 100 Hz/hr
Remarks	Exceptionally well made small portable. Above average reception. Has 32 memories, dual clocks, programmable timer, sleep function. Good audio. Carrying case included.

RF-section

	Frequency	Bandwidth wide	narrow	SSB
Sensitivity in µV for 10 dB S+N/N on SW				
AM modulation with 400 Hz	.15 MHz	470		
at 30% for 26 dB S+N/N up	.50 MHz	42		
to 1.5 MHz	1.00 MHz	40		
	3.00 MHz	1.8		
	5.00 MHz	1.8		
	7.00 MHz	1.7		
	10.00 MHz	1.8		
	20.00 MHz	2.0		
	30.00 MHz	2.0		

	wide	normal	narrow
Bandwidth at –6/–60 dB in +/– kHz	4.8/18.6		

Image rejection	68 dB
AGC range	79 dB
ICP 3. order	not measured
Dynamic range	adequate
Tuning indicator	S1 2 µV
	midscale 18 µV
	end 460 µV
Antennas	telescope 85 cm, ferrite rod
Antenna connectors	yes, 3.5 mm mini plug
Remarks	– 20 dB attenuator switch

AF section

Audio power	.45 watts at 10% THD
Audio frequency range	130 Hz – 9.4 kHz
Tone control	High/Low switch, moderately effective
Noise limiter	none
Speaker	8 cm 0, 8 ohms
Connections	external speaker or headphones

General

Power supply	4 AA cells or external 6 VDC at .3 A max
Power consumption	approx. 1 VA
Dimensions	205 × 120 × 36 WHD in centimeters
Weight	.795 kg (1.75 lbs)
Accessories	manual, frequency list, leatherette case
Price	List US$269-

Miscellaneous

FM sensitivity	2.8 µV for 26 dB SINAD
Spurious signals	– 55 dB
Accuracy of clock	+/– 6 seconds/monthly

Panasonic RF-B60/L

Matsushita continues their series of small, high quality portables with this contemporary looking travel radio.

Small and beautiful

The RF-B60 is a relatively small portable multi-band radio. This black beauty looks very expensive, is built with swiss-like precision and not only offers good looks but also a multitude of functions. Above all, this little receiver is a capable performer as we will see later on.

The set receives the range from 155 kHz to 30 MHz with small, unimportant gaps, see table. In addition, the FM segment from 87.5 – 108 MHz is covered. Several tuning methods are available:

- manual (step) tuning with either the large rotary control or UP/DOWN keys
- direct frequency entry via keypad
- memory recall (32 memories total)
- automatic tuning (scanning)
- direct access to SW meter bands from 120 m to 13 m

Two tuning steps are selectable, see table.

The large LCD shows frequency, range, memory channel, signal strength, Time 1 or Time 2, and ON/OFF times for the built-in timer function. The clocks can be set independently, e.g. local time or UTC. The timer circuit is referenced to Time 1.

Signal strength indication is in graphic form, with up to 15 vertical bars of varying length. When the radio is switched on, either Time 1 or Time 2 can be displayed with the push of a button. When the radio is off, the selected time is shown permanently. All times are displayed in 24-hour

ROTARY TUNING

BAND / TUNING STEP	FM	LW	MW		SW
FAST	100 kHz	9 kHz	9 kHz	10 kHz	5 kHz
SLOW	50 kHz	1 kHz	1 kHz	1 kHz	1 kHz

STEP TUNING

FM	LW	MW		SW
100 kHz	9 kHz	9 kHz	10 kHz	5 kHz

Note: 9 kHz/10 kHz steps can be set with a small switch located in the battery compartment. In Europe, the channels on MW (BCB) are only 9 kHz apart, in other parts of the world (e.g. U.S.A.) a channel spacing of 10 kHz is used.

format. The SLEEP function operates with a fixed interval of 60 minutes.

The front panel is studded with a total of 29 keys. Clean styling, a tasteful color scheme and some very clever optical and mechanical tricks give the impression of uncluttered functionality. Indeed, the set is easy to operate, and the multitude of functions (e.g. memory read/write, scan, timer operation) can be handled without lengthy studies of the (excellent) manual.

For each range, i.e. LW, MW, SW, and FM, nine frequencies can be memorized. In addition, the last frequency used is recalled when the set is switched on.

Volume and tone controls are located on the left side panel. The HOLD function prevents accidental activation of the radio's electronics when the set is carried or packed in a crowded piece of luggage. The tuning knob is also accessible on this side, together with the tuning step selector.

Several connectors are set into the left side of the cabinet. Provisions are made for an external antenna, an external DC supply, and headphones. There also is a small switch for the antenna signal attenuator (– 20 dB).

The long telescope is mounted on top, it can be stored in a fitted groove. A black and red plastic sleeve around the antenna's base section prevents any damage to the receiver's cabinet when the antenna is tilted in an extreme angle. Part of the cabinet's top can be opened. Here memory assignments and other important notes can be stored. When not in use, this spring-operated flap folds down neatly and is absolutely flush with the cabinet's surface.

Two battery compartments with identical covers are located on the back. The radio needs four AA cells, the memory and clock circuits are powered by two more AA batteries. A fold-out stand is provided to put the radio at a convenient angle for easier operation when the set is placed on a table. A tiny time zone chart is printed on the back, along with a table of short wave frequency allocations (radio bands only).

Power ON/OFF switching utilizes an electronic circuit. The radio can be activated either with the key marked POWER or by the built-in timer. The LCD area can be illuminated.

The cabinet and the various controls of the RF-B60/L are a shiny example of precision manufacturing. **In more than 20 years I have not seen another small portable that could quite match the precision and quality exhibited by this little radio from Japan.**

What's inside?

The pretty outer shell hides a sophisticated electronic package. The RF-B60/L is a double superhet (1.8 – 30 MHz), with intermediate frequencies of 55.845 MHz (!) and 450 kHz. The input circuit (front end) is wide band, with an RF preamplifier and a single low pass filter followed by a balanced FET mixer. The 1st IF is filtered, buffered and subsequently processed in a multi-purpose IC. A single ceramic filter is used, the demodulated output is amplified in another integrated circuit and fed to the speaker. The schematic diagram must be studied very carefully, there are several interesting details and some rather innovative solutions to circuit design. Electronic switching is used extensively to minimize current consumption. The PLL synthesizer is built with a custom-made LSI, another μP controls the mode and switching logic, the display, and several auxiliary circuits, e.g. timer and clock(s). The amount of electronic parts (active and passive) shown on the diagrams is almost unbelievable, one can hardly see how all of this can be crowded into the relatively small cabinet.

Does it perform as good as it looks on paper? I think it does; the RF-B60/L is slightly, but decidedly better than Sony ICF-7600D (ICF-2002) and/or Toshiba RP-F11. The quality of reception is not always better all the time, but there are other important facts: Excellent audio, easy operation, and lots of convenient features. The liquid crystal display is very informative, showing frequency, band, and signal strength at a single glance. It is a joy to operate this little receiver. The outstanding finish, the feel of the solid controls and the satisfying quality of reception are a rare combination. I'd call this a near perfect travel radio. Of course, the RF-B60/L suffers from all the ailments that come with this type of construction. There are overloading effects at times, the attenuator can be quite helpful in this case. The single ceramic filter is a compromise between good sound and decent selectivity. But, stations 5 kHz apart can be received by detuning slightly. There are few self-generated birdies and whistles. Circuit noise is noticeable, but not annoying.

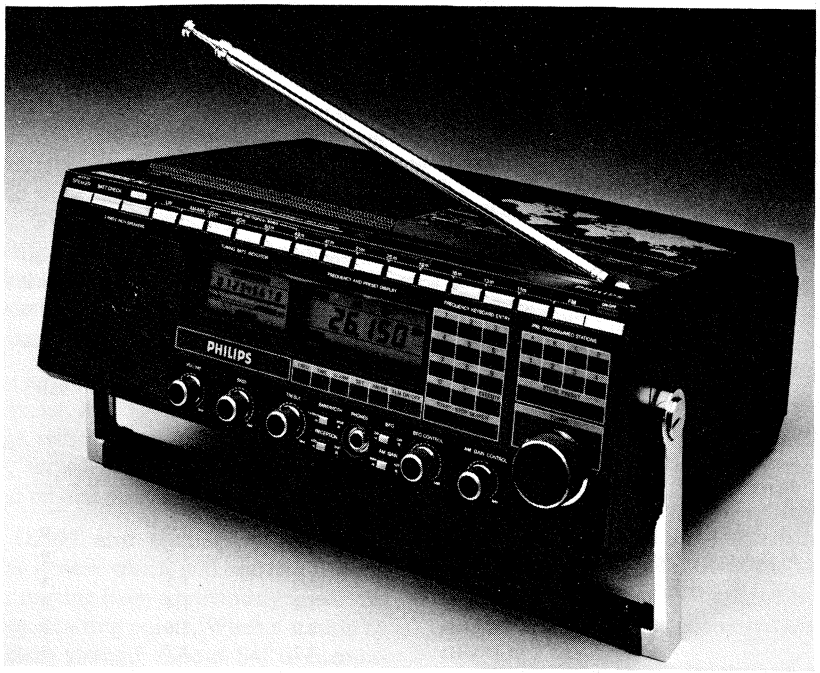
Besides good shortwave reception, the RF-B60/L performs quite nicely on LW, MW (BCB) and FM. As a matter of fact, the FM section is the best I've seen in a small portable. For shortwave reception, active external antennas are not recommended. Wire antennas should not be of excessive length, about 20′ will do nicely.

BAND	FREQUENCY RANGE
FM	87.5 - 108 MHz
LW	155 - 519 kHz
MW	522 - 1611 kHz (9 kHz steps)
MW	520 - 1610 kHz (10 kHz steps)
SW	1.615 - 29.999 MHz
SW	1.615 - 26.100 MHz (West Germany)

Incidentally, good results were obtained with the tunable Yaesu FRA-7700 indoor active antenna.

Don't get a false impression, this is not the all-out hot little DX receiver with SSB, switchable filters and what have you. Instead, the RF-B60/L is a small, reliable companion for travels or mobile use. The radio gives a satisfying experience every time it is used. Obviously, the manufacturer is aware of this high-tech quality: The set comes with a beautiful soft leatherette case. Also included is a frequency list. **This little booklet is next to useless, it is about 4 years out of date.** Certain models are delivered with an auxiliary wire antenna. An AC adaptor is optional.

This is one of the few portables I have bought for my personal use. It simply is a great little receiver.



Philips/Magnavox D2999

Philips introduced two new receivers in 1985. The D2999 is a full-sized stationary type whereas the D2935 is a mid-sized portable. This new line will replace the unsuccessful AL 990 and the completely outmoded D2924. This test report covers the larger D2999 only.

Nice package, interesting features

The modern and businesslike front panel of the D2999 hides a newly developed PLL synthesizer, controlling a dual superhet circuit with a very high (about 50 MHz) first intermediate frequency. One microprocessor interfaces with the multitude of front panel knobs and buttons, while another μP controls the PLL circuit. This setup makes some interesting features possible:

- all standard shortwave bands (except 22m) can be accessed directly with the top row of buttons
- all other standard broadcast ranges (e.g., FM, BCB, LW) can also be reached this way.

A tiny red LED adjacent to each button indicates the selected range or the selected band.

Direct frequency input is also possible, leading zeroes are not required. Upon EXECUTE, the set immediately tunes to the

Philips/Magnavox D2999

Manufacturer	Philips, Eindhoven, The Netherlands
Type of receiver	communications type, stationary
Type of circuit	double superheterodyne, PLL synthesizer
Frequency coverage	LW,MW (BCB), FM, SW 1.6 to 30 MHz
Display accuracy	100 Hz
Frequency stability	+/−45 Hz/hr.
Remarks	Modern design, sturdy construction. Has direct access tuning, direct band access, automatic searching. 16 memories, digital clock, excellent audio section. Two filters, external antenna input. Can be operated from batteries.

RF-section

	Frequency	Bandwidth wide	narrow	SSB
Sensitivity for 26 dB S+N/N	.15 MHz	140	130	–
below 2 MHz	.50 MHz	130	120	–
Sensitivity for 10 db S+N/N	1.00 MHz	120	113	–
above 2 MHz	1.50 MHz	120	105	–
	2.00 MHz	100	92	–
	3.00 MHz	2.6	1.8	.9
Modulation 400 Hz at 30%	5.00 MHz	2.2	1.5	.9
	7.00 MHz	2.0	1.5	.8
	10.00 MHz	1.8	1.4	.8
	20.00 MHz	2.0	1.6	.9
	30.00 MHz	2.2	1.7	.9

Bandwidth at −6/−60 dB	wide	normal	narrow
in +/− kHz	6.1/17.8	2.8/7.6	2.8/7.6

Image rejection	58 dB
AGC range	84 dB
ICP 3. order	−12 dBm
Dynamic range	87 dB
Tuning indicator	S1 2 μV
	midscale 45.5 μV
	end 650 mV
Antennas	telescope 160 cm, ferrite rod
Antenna connectors	DIN-coax, separate for AM and FM
Remarks	internal antennas may be switched off.
	20 dB attenuator provided.

AF section

Audio power	6 watts at 10% THD (mains power)
Audio frequency range	110 Hz − 14.2 kHz (+/−3 dB points)
Tone control	+/−8 dB at 1 kHz
Noise limiter	none
Speaker	8″ woofer, 5″ midrange/treble
Connections	external speaker, earphone, record

General

Power supply	110/220 VAC or 12 to 15 VDC or six D cells
Power consumption	AC 16 VA, DC 8 VA
Dimensions	33 × 11 × 28 6 WHD in centimeters
Weight	approx. 4.85 kg (10.5 lbs)
Accessories	manual, schematics SW, primer
Price	List US$ 399.

Miscellaneous

FM sensitivity	1.8 μV for 20 dB SINAD
Spurious signals	58 dB below wanted signal (worst case)
Accuracy of clock	−14 seconds/month

desired frequency. Manual tuning operates electronically with three speeds which are selected by the μP, depending on the tuning knob's rate of rotation.

The PLL circuit operates in either 1, 2, or 10 kHz steps on all AM ranges. On FM, the tuning steps are changed to 10, 20, or 100 kHz. The frequency resolution (and settability) of 10 kHz in the FM mode is remarkable. There is no automatic muting between FM stations, so this tuning accuracy can be fully utilized for FM DX.

There are 16 memories, arranged in a 4 × 4 matrix, i.e. A1 to A4, B1 to B4, and so on. Range switching is performed automatically, so AM and FM stations may be stored on any memory location.

The D2999 also features an automatic search system which will search upwards only, starting from a previously tuned frequency (starting point). When a station of sufficient strength (about S4) is encountered, the search stops and the audio (which was muted) is turned on again. This search may be stopped at any time by hitting the SEEK button. This function only operates within the 14 selectable frequency segments (11 × SW, FM, BCB, and LW).

The memory and the digital clock circuits are buffered by three AA cells which last approximately for two months when the set is disconnected from the mains supply.

More features

A large (6″ diameter) midrange/woofer is located on top and may be switched on in addition to the smaller front-radiating midrange/treble unit. This combination delivers excellent sound, thanks to the generous design of the audio output stage. As a matter of fact, the audio quality of the D2999 is quite comparable to that of the renowned Grundig Satellites.

The large LCD shows frequencies in kHz on all AM ranges and in MHz on FM. Time is displayed when the set is switched off or when the button marked TIME is pressed. The electronic clock is combined with a timer circuit which can be used to sound a buzzer as a wake-up alarm, – it does not switch the radio. This is hard to understand, considering the set's price. (When introduced, the price was US$ 399. – !)

The time display can be changed to show the standard 24-hour format. The large signal strength meter looks like an LCD, but in reality is a standard, old fashioned analog meter with a non-standard scale from 0 to 8. This meter is also used for the battery-check function.

Both displays (frequency and signal strength) can be illuminated with the button marked LIGHT when the set is running on batteries. This light is on constantly when mains power is used.

Besides the already mentioned AA cells, six D cells are needed for mains-independent operation. A mains operated supply is built in, the line cord can removed completely. The set can also be powered by an external DC source. 12 VDC at about 600 mA are specified.

All standard controls, i.e. volume, tone, BFO, and RF gain are straight, no-nonsense rotary knobs. The large tuning control has 50 barely noticeable detents; in practice this control behaves like any old-fashioned analog tuning control. Two IF bandwidths are selectable, the other tiny pushbuttons in the center of the front panel are used to:

- introduce approx. 15 dB attenuation between antenna and front end
- switch the beat frequency oscillator (BFO)
- change manual RF gain control to automatic gain control.

The large ¼″ phone jack is wired for stereo headphones. This is a very good idea, but the placement must be criticized. When in use, the large plug sticks out from the

panel and interferes severely with the set's operation.

The rear of this receiver shows the usual array of connectors:

- audio out (cinch and DIN)
- speaker output (DIN)
- external DC input (standard jack)
- external antenna (two separate coax inputs for AM and FM)

The very long telescope (63"!) can be stowed in a recessed groove on top of the cabinet. The large carrying handle can be tilted upwards or completely removed.

The entire electronics are housed in a sturdy plastic cabinet. The overall impression is very good, the designer's concept was neatly executed.

Good reception, good sound

The receiving section has adequate, if not satisfying properties. With good sensitivity, quite useful selectivity (narrow bandwidth only), and an amazing array of user-friendly features, this receiver is tailor-made for the discriminating SWL. Some minor quirks make rock-bottom DX somewhat problematic. There is a wide filter which is next to useless on the shortwave ranges, and a narrow filter with pronounced imbalance in its characteristics. The 5 kHz channel spacing on shortwave can be managed just barely with this filter. The greatest problem, however, is the limited dynamic range. Of course, the attenuator (LOCal/DIStant) will help somewhat, but at the same time overall sensitivity is reduced and weak stations will get lost in the familiar background roar of cross- and intermodulations. Active electronic antennas are not recommended for this set because of their large signal output.

The D2999 can satisfy most demands when used for shortwave listening, i.e. monitoring the larger networks like BBC, VOA, RSA, DW, ORF, SRI, and the like. A strong signal will drown adjacent interference; the excellent audio section of this receiver makes long sessions with your favourite station a delight. There are very few mirror images, internally generated birdies are limited to rarely used frequency ranges. With the strong stations mentioned above, the attenuator does no harm to the signal (it remains strong enough), but the lowered input power will very effectively improve the dynamic properties of this receiver.

LW and BCB reception are hampered by the need to move the large cabinet when aligning the built-in ferrite rod to the direction of the incoming signal. With an external directional antenna, this set is suitable for BCB DX. All signal controlling features (RF gain, filters, attenuator) remain functional down to the set's lower frequency limit at .15 MHz.

FM reception is outstanding. This definitely is one of the best sounding portables around. Battery consumption is high when the audio is cranked up all the way. The large woofer needs lots of current. I'd recommend mains operation when large volume levels are demanded.

Summing it up

The D2999 is a good looking, solidly built receiver with interesting features and excellent sound reproduction. The flexibility of the power supply (internal DC, external DC, mains) should also be considered.

A true DX machine this is not, but rather a very satisfying SWL device. Memories, direct frequency access, and the intelligent layout of controls combine with good audio properties to make a nice package. An occasional detour into the frequency ranges used by hams is quite possible, thanks to the set's good sensitivity and the stable BFO. DX is limited to ranges where signal density can be handled by the front end of this receiver. An external preselector is recommended when DX performance is needed later on.

In a side-by-side comparison, this new Philips compared quite favourably with the Bearcat DX-1000. At the present price, the D2999 must be considered a bargain.

Update

Good looks, but mediocre DX performance, - this is the conclusion of my review of this receiver from Philips.

Late in 1986 an improved version appeared, with certain circuit changes and some added shielding around critical sections. Look for sets with serial numbers above 7500. The "improved" model was found to perform somewhat better than earlier models, but overall the improvements appeared to be superficial. There still are overloading effects when an external antenna is connected. Quite some image frequencies are received, and on certain ranges (above 22 MHz) complete segments from other parts of the radio spectrum appear.

No changes were made to the LW, MW and FM sections, these are above reproach.

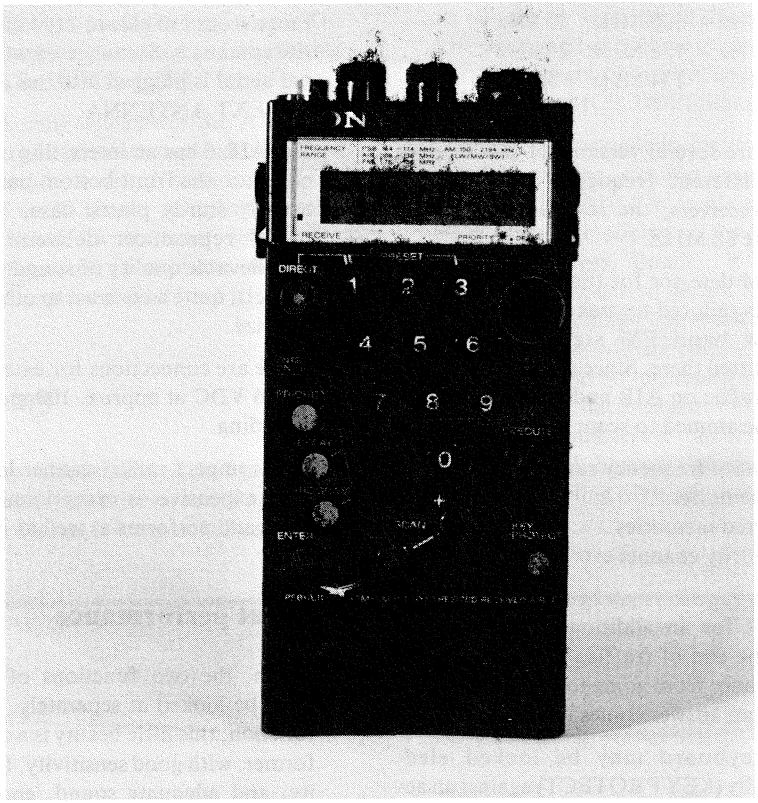
Contrary to other opinions, I can not recommend this receiver for DX. It is a useful SWL device, with very good audio, numerous convenient functions and easy operation. The flexible power supply (AC, DC, or batteries) could be a decisive factor when a powerful (audio only) multipurpose receiver is desired.

Performance of the D2999 is still substandard on shortwave, - even when discounted to below US$300-

Sony AIR-8

Technical Data and Measurements

Type of receiver	portable radio receiver/VHF scanner
Frequency coverage	150 kHz-2194 kHz (LW, MV, MB) 76 (88) MHz-108 MHz (FM) 108 MHz-136 MHz (AIR) 144 MHz-174 MHz (PBS)
Modes	according to range, no SSB
Bandwidth (at −6 dB)	FM narrow 15 kHz, FM wide 165 kHz AM 6 kHz
Circuit type	single superhet on AM and FM double superhet on AIR and PSB
Image rejection	50 dB
Sensitivity for 10 dB S/N	FM narrow .5 μV, FM wide 1.6 μV AM 8.4 μV
Tuning steps	150- 530 kHz: 1 kHz 531-1602 kHz: 9 or 10 kHz (selectable) 1608-2194 kHz: 1 kHz 76- 108 MHz: 50 kHz 108- 136 MHz: 25 kHz 144- 174 MHz: 5 kHz
Frequency display	numeric, 1 kHz resolution
Memories	10 for each range (AM, FM, AIR, PSB)
Audio power	.4 watts into 8 ohms
Dimensions	8 × 19 × 4.8 WHD in cm
Weight	.68 kg (1.5 lbs)
Power required	6 VDC at 100 mA
Accessories	11″ rubberized antenna, manual, earphone
Price	approx. US$275.00



Sony AIR-8/7

This little multi-purpose scanner/receiver is one of the most interesting radios I've seen in years. At first glance, the AIR-8 looks like one of those expensive scanners, but there is a lot more.

One receiver, two functions, two names

This marvellous piece of electronic ingenuity is also known as AIR-7. Not only are there two names, the receiver also has two functions. There is the standard radio part with LW, MW (BCB) plus marine band, but there also is the scanner part with separate frequency ranges from 108 to 136 MHz and 144 to 174 MHz. This covers a lot of services like airport traffic, telephone links (in certain countries), public service, emergency, police, fire, 2m ham radio and a multitude of others. Each range has 10 memories. Frequencies may be entered via the keyboard (direct access), or called from memory, or by stepping through the frequency range of interest in certain pre-programmed steps. These are set at the factory:

150 kHz - 530 kHz	1 kHz
531 kHz - 1602 kHz	9 kHz or 10 kHz (user selectable)

1608 kHz	-2194 kHz	1 kHz
76 MHz	- 108 MHz	50 kHz
108 MHz	- 136 MHz	25 kHz
144 MHz	- 174 MHz	5 kHz

There are several versions of this receiver with different frequency coverage. In some receivers, the standard FM range starts at 88 MHZ.

The FM detector for the upper frequency range is tailored to make the most out of narrow band FM signals which are transmitted there. Since there is no continuous traffic on AIR and PSB, the set can be programmed to scan:

- all entire frequency range
- all memories
- selected memories
- a priority channel every three seconds.

A delay function may be set to hold on to a channel for an additional three seconds after the end of traffic. This will prevent the scanner from going to the next channel before an answer comes in.

The keyboard may be locked electronically (KEY PROTECT) against an accidental change of settings. Frequency, mode, memory allocation, and other parameters are displayed on the large LCD, which can be illuminated for about 15 seconds by pressing a little button on the right hand side of the receiver cabinet.

Several controls are crowded on top of the set:

- on/off pushbutton
- volume control
- squelch control (push for preset level)
- band selector.

In addition, there is one minijack for an earphone and another for external AM antennas. FM, AIR, and PSB use the included "rubber duck", a miniaturized helix-wound rod antenna, a very fashionable and attention getting item. No cheap tricks here, a commercial quality BNC connector is provided. The antenna itself is fairly effective, despite the small size. A ferrite rod inside the case is used for the range from 150 kHz to 2194 kHz. This ferrite antenna is disconnected when an external aerial is plugged into the jack labelled AM EXT ANTENNA.

The AIR-8 has an interesting oval speaker built into the front bottom part of the extremely sturdy plastic case. This special sound reproducer delivers an almost unbelievable quality of sound (speech and music!), quite a contrast to other radios of this size.

There are connections for external DC input (6 VDC at approx. 100 mA) and tape recording.

This compact radio/scanner looks downright expensive, is exceptionally well finished and performs as well as it looks.

Great performance

Again, the two functions of the AIR-8 must be looked at separately. In its radio function, this little beauty is a capable performer, with good sensitivity, fine selectivity, and adequate sound, enough to fill even a large hotel room. If the memories are programmed, this little box turns into a marvellous entertainer at the push of a button. No searching for stations in a strange city, just set the radio to search the bands and enter every station you like into the memory. This takes about two minutes. From then on 20 stations (10 on AM, 10 on FM) are ready at your command. If you want the ultimate, get yourself a pair of those little amplified speakers made by Sony, e.g. APM-007 or SRS-50. These units provide excellent sound at ample volume levels, enough for a small party in your home or hotel room. Don't forget to buy a matching mono to stereo adapter plug; the AIR-8 is a monophonic device and those speakers come in pairs only.

If you want to know what's going on outside, change the band to AIR or PSB and let the little receiver excel at its scanning function. The squelch can be set very accurately, between transmissions or on empty channels the speaker remains really quiet, no background noise whatsoever. The BNC connector allows the use of external antennas for AIR and PSB.

Four AA cells will power the AIR-8 for about 10 to 12 hours continuous use. In the scanner mode, a set of batteries will last about 25 to 30 hours. A stylish carrying strap is included with the set, so are a detailed manual and an earphone. A leatherette case is optional (and hard to find).

Summary

The Sony AIR-8 a.k.a. AIR-7 is an interesting marriage between radio and scanner. The set is exceptionally suited for travelers. Although this is not a shortwave receiver per se, I feel this particular product should be included in this book. The AIR-8 is bound to become a collectors item like the venerable Barlow Wadley XCR-30 or Sony's own ICF-7800 folding radio.

Considering the built-in features and the stylish packaging, this radio is well worth its price. The AIR-8 is vastly superior to other, cheaper models with these extended frequency ranges. Besides, it also is an unbelievable attention getter. Just take it out of your pocket or bag and let it be seen. Within minutes you are talking to friendly strangers. I was so impressed by this particular model that a lengthy letter was sent to Sony headquarters in Japan, suggesting a full-featured shortwave receiver with the interesting styling of this little marvel. Just wait and see . . .

Ten-Tec RX325

Manufacturer	Ten-Tec, Inc., Sevierville, Tenn., 37862
Type of receiver	small communications, stationary
Type of circuit	double conversion
Frequency coverage	300 kHz to 29.9999 MHz
Reading accuracy	100 Hz
Absolute accuracy	– 43 Hz
Frequency stability	+ / – 23 Hz per hr
Remarks	Miniaturized communications receiver with interesting features. Has 25 memories, clock, and timer. Can be operated on DC.

RF-section

	Frequency	Bandwidth wide	narrow	SSB
Sensitivity for 10 dB S + N/N	0.15 MHz	–	–	–
AM-modulation 400 Hz at 30%	0.50 MHz	30	30	4
	1.00 MHz	30	30	2.4
	2.00 MHz	2.7	2.8	.8
	5.00 MHz	2.5	2.2	.7
	7.00 MHz	2.2	2.2	.6
	10.00 MHz	2.3	2.0	.6
	20.00 MHz	2.6	2.5	.7
	30.00 MHz	3.0	2.7	.8

Bandwidth at – 6/ – 60 dB in kHz	SSB	wide	normal	narrow
Image rejection				
AGC range				
ICP 3. order	– 7 dBm			
Tuning indicator	S1			
	midscale			
	end of scale			
Antennas	none			
External antenna connections	SO-239 (UHF) and clamps for high impedance and low impedance serials			
Remarks	rf attenuator, – 18 dB			

AF section

Audio power output	1.6 watts
Audio frequency range	120 – 8,100 Hz
Tone controls	none
Noise limiter	none
Speaker	4" 8 ohms
Connections	external speaker, earphones, record, switched control of recording device

General

Power supply	wall plug adapter or 13.8 VDC at .6A
Power consumption	approx. 6 watts
Dimensions	24 × 8 × 18 WHD in cm
Weight	2.4 kg
Accessories	manual, wall plug adapter

Ten-Tec RX325

This marvel of miniaturization was introduced by Ten-Tec early in 1986. The company is well known for its excellent ham equipment. The RX325 is the first receive-only set offered by this renowned maker.

Small, but sturdy

The RX325 really is a tiny black box, weighing a scant 2.4 kg (5 lbs., 5 oz.). This was made possible by doing away with a built-in power supply. Instead, the radio comes with a wall-plug adaptor which delivers 13.8 VDC at about 1.6 A. This power unit is of conservative design, the little receiver needs only about .6 A of current. The external power supply has some advantages: the receiver can be run on a car battery, or any rechargeable battery of adequate capacity. The non-existing power transformer cuts weight and, probably more important, it does not induce interferences into the sensitive receiver circuitry. On the other hand, the company saves quite a bit of money, because the circuits can be designed rather economically, – there is no direct interference problem.

Conceptwise, the RX325 is a microprocessor controlled communications receiver covering the frequency range of 300 kHz to 29,9999 MHz. Synthesized frequency generation is used with the familiar phase locked loop technique. The circuits are built with standard parts, not the new leadless component chips. The block diagram shows straightforward design, with diode-switched bandpass filters, dual conversion, and a microprocessor controlled functions block. Somewhat disappointing is the use of the consumer grade integrated circuit TCA 440 in the 2nd IF chain. The entire electronics are housed in a sturdy, all metal cabinet. Workmanship is fair, the handwriting of fast assembly line production is all too evident. Besides a wall plug adaptor, an accurate but carelessly printed manual and some accessories (plugs, fuses) are provided.

The multitude of front panel markings indicates heavy utilization of microprocessor control. Indeed, besides standard functions several rather novel features are provided.

Possibilities . . . .

Desired frequencies can be reached by direct access (keypad) tuning, the required format is MHz, so you must input the decimal point. If the remaining kHz numbers are all zeroes, they need not be entered. Erroneous entries can be erased by hitting CLEAR.

The fairly large tuning knob will adjust frequencies up or down. Depending on mode setting and selected tuning rate (FAST or SLOW), the uP will automatically select an appropriate step size. On AM, the steps are either 50 Hz or 1 kHz, on SSB 50 Hz or 500 Hz. The display has only 100 Hz resolution, the 50 Hz steps are internally used values.

There are 25 memories for frequency and mode. A 9 volt block battery must be installed to provide backup power. This battery is located in a small compartment on the rear. The memory function offers interesting possibilities:

- automatic memory assignment (next free location)
- automatic memory call-up with adjustable holding time
- one temporary memory (scratch pad)
- memory lockout (in conjunction with call up routines)
- mode selective memory scan
- clear all memories

In automatic scan mode, the scanning rate is programmable between .3 and 12 seconds. Of course, scanning (automatic station search) can be done not only within the memories, but also between programmable frequency limits.

Step size is variable, so is the speed of this automatic tuning. A digital clock is built in, times can be displayed in either 12 or 24 hour format. If desired, this clock will also display seconds. A timer circuit is provided, together with a corresponding switching output for a recording device. This timer uses memory location 00 for frequency and mode. Both on-time and off-time are programmable. Incidentally, the entire high power section of the audio stage is disabled when the timer is activated, audio is channelled only to the recording jack.

Two AM filters are selectable, they are specified at +/−4 kHz and +/−2.7 kHz at −6 dB. For SSB reception (and sometimes quite helpful when receiving amplitude modulated signals) the release time of the automatic gain control circuit (AGC) can be switched to either fast or slow.

A novel feature is the display test. Upon pressing F plus ENTER all segments of the blue/green fluorescent display are activated.

The main functions are grouped nicely between tuning knob and volume control. MEM allows memory recall by turning the tuning knob, LOCK freezes the manual tuning. FAST controls the step size, AGC changes the time constant of the AGC. NB activates a noise blanker, and FLTR is used to select the desired IF filter.

The large bar above the tuning knob can be used to step up or down in increments/decrements of 1 MHz. If this switch is held down for more than .5 seconds, the frequency will change continuously. This switch can also be used in conjunction with the RATE key to change scanning speed, or to change the direction of scanning.

DIM reduces the brightness of the display, and ATT introduces about 18 db of attenuation to the antenna signal. The small analog S-meter is illuminated, it can be read easily. It shows signal levels from S1 to S9 + 40 dB (sic!), but there are also corresponding marks from 1 to 5 for the S-value of the SINPO code. This meter's calibration is fairly accurate, S9 is reached with about 70 uV at the antenna input.

Despite the miniaturization, the RX325 can be operated quite easily. The keys are labelled clearly, the soft material used is not detrimental to fast and efficient operation. The group of nine miniature pushbuttons between volume control and tuning knob is easy to reach. Unfortunately, no indicators are provided to show the switch position, the digital display has no status reports as in e.g. FRG-8800. Only the mode setting (AM, LSB, USB) is reported with tiny red LEDs adjacent to the respective pushbutton.

In accordance with the miniaturized concept, a 3.5 mm jack is used to connect headphones. This jack is wired for stereo, so you can use the lightweight walkman-type variety. On the rear, the usual array of connectors can be found:

- UHF for antenna input (Z = 50 ohms)
- clamps for high Z and low Z wire antennas, plus ground
- DC power input
- recording output
- switching output for recorder
- external speaker output (¼")

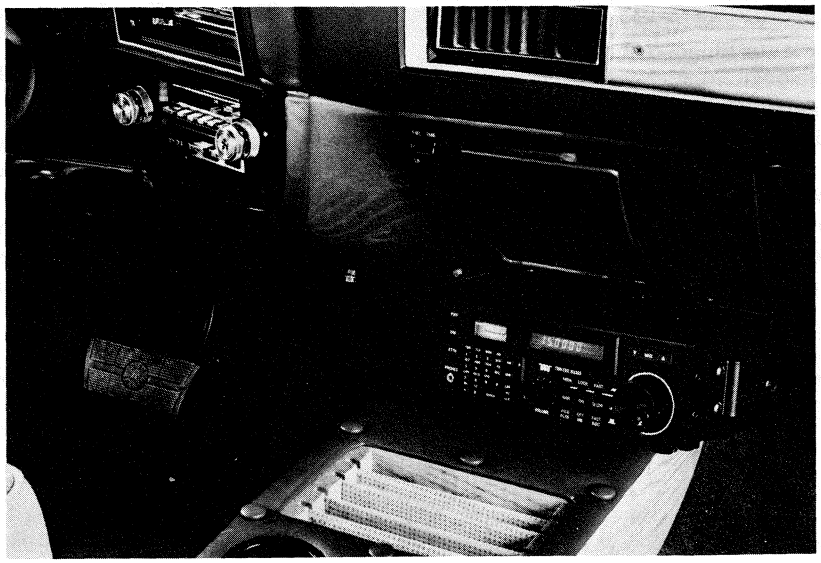
There is also a multi-pole Amperex connector marked ACC. The handbook laconically states: For use with future optional accessories that require connection to the receiver's microprocessor. Well . . . . .

Incidentally, the scant manual (about 30 pages) contains all necessary information, up to and including some quite useful hints on how to build antennas, on propagation, and frequency allocation.
The built-in loudspeaker radiates from the bottom of the cabinet, an unfortunate location and one of the dumbest engineering mistakes I've come across in years.

. . . and performance

The RX325 is a fascinating piece of gear, — and be it only for its miniaturized construction. Price and advertising put this receiver in a bracket with well known stationary receivers, a promise which this little unit can not quite live up to. The set is quite easy to operate once you've mastered the intricate programming of the uP. The tuning knob is an appalling cheap construction, a real 5¢ item. But otherwise, the set does everything it is designed to do.

What comes out of this radio is an entirely different matter. The sound is bass-heavy, even when good quality headphones are used. Also, volume increases very fast when the volume control is turned just a little bit. Circuit noise is high. The AGC is very aggressive, when tuning across the



bands the receiver appears "noisy." On the other hand, this AGC copes very well with a variety of input signal conditions. Frequency stability is very good, even right after power-up the drift is negligible. Sensitivity is allright, this is not one of the high-sensitivity, fast-overloading constructions. Extremely high sensitivity (below 1 uV) is not really useful, the background interference even in quiet locations is typically in excess off 10 uV. When compared with the FRG-8800, the useful sensitivity of the RX325 was quite adequate to receive even weak ham signals. But there are other problems. On certain ranges (notably at the limits of the band pass filters in the input circuit) pronounced rf-section problems appear. There are mirror images, cross- and intermodulations, and overloading effects, – the entire tell-tale signs of fast and sloppy circuit design. Of course, the attenuator will do away with most of these interferences, but you'll also lose 18 dB of the signal. It may only be a small consolation, but almost all of these problems can be eliminated by using a tuned antenna. This could either be any wire antenna with a high quality matchbox, or an active tuned antenna, e.g. FRA-7700. But, by all means, build and use a separate attenuator (– 3, – 6, – 10, – 20 dB) and insert this device between antenna output and receiver input. In practical use it was found, that sometimes only 3 dB of attentuation could reduce most of the undesired effects mentioned above. The RX325 can not be used successfully with wideband active antennas, e.g. Dressler ara-30 or Dymek DA-100D/M. On medium wave (BCB), specialized frame constructions (magnetic field antennas) are recommended. Interestingly, on clear band segments the RX325 offers quite satisfying performance. The filters are fine, and especially SSB stations could be received with surprising clarity. 50 Hz steps are a bit too much for all-out SSB demodulation, and some realignment of the internal master oscillator may become necessary to obtain clean zero-beat tuning. Unfortunately, no vernier tuning (RIT) is provided, so decoding of complex RTTY signals is out of the question. There is an optional high quality SSB filter available which I'd recommend if serious work with SSB signals is to be done. If narrow band (tuned) antennas are used, performance in the ham bands is quite laudable. This could make a nifty little auxiliary receiver in the shack or in your car.

Summary

The Ten-Tec RX325 is a nice little package with numerous convenient features. The small dimensions could be a decisive argument for specialized applications, e.g. portable use in remote locations. It is quite possible to fit this receiver into a standard attache case, along with a long lasting Ni-Cad accumulator and charger.

Audio quality is below any reasonable expectations, so an external speaker is mandatory. The set suffers from several ailments in the rf-section (see above) which can be combatted by using the right antenna and an outboard attenuator.

Overall, the RX325 is not quite fulfilling the promise of being a full-fledged communications receiver. The price is somewhat doubtful, although a premium has to be paid for the miniaturized concept and the intelligent and convenient operational features.

Yaesu FRG-9600

This tiny communications receiver was introduced to the world market early in 1985. The frequency range of this receiver is somewhat unusual, the set covers 60 MHz to 905 MHz. The FRG-9600 actually is a programmable scanner with continuous frequency coverage and lots of interesting features.

Tiny, but powerful

The diminutive looking metal case is wrapped around some state-of-the-art circuitry and an ingenious ROM based operating concept. Even a close look at the front panel reveals only part of the possibilities hidden behind all those push-buttons.

Let's start out with the frequency range. This set indeed covers 60 MHz to 905 MHz without any gaps, but an exclusion of some operating modes, e.g. no SSB above 460 MHz. Tuning accuracy is 100 Hz when needed (AM and SSB), the display actually shows this remarkable frequency resolution. The following modes of operation are available:

- FM wide (for standard FM radio stations)
- FM narrow (used by hams, utility and government stations)
- AM wide (for ham traffic and special signals)
- AM narrow (for ham traffic, airport traffic, and others)

USB/LSB (for ham traffic, RTTY, SSTV, FAX, and special services

For these modes of reception/demodulation, tuning step size and filters may be set accordingly:

Mode	Step	Filter
FM wide	100 kHz	wide (180 kHz)
FM narrow	5, 10, 12.5, 25 kHz	narrow (15 kHz)

Yaesu FRG-9600

Technical Data and Measurements

Type of receiver	VHF/UHF communications receiver/scanner
Frequency range	60 MHz to 905 MHz
Modes	AM, FM, SSB
Bandwidth (at −6 dB)	FM narrow 15 kHz, FM wide 180 kHz AM narrow 2.4 kHz, AM wide 6 kHz SSB 2.4 kHz
Circuit type	triple superhet on FM narrow, AM, SSB double superhet on FM wide single superhet with auxiliary TV board
IF frequencies	1. IF 45.754 MHz, 2. IF 455 kHz
Image rejection	50 dB in the range from 60 to 460 MHz 40 dB in the range from 460 to 905 MHz
Sensitivity for 10 dB S/N	FM narrow .35 µV, FM wide .85 µV AM narrow .85 µV, AM wide 1.4 µV SSB .65 µV
Tuning steps	FM narrow 5, 10, 12.5, 25 kHz FM wide 100 kHz AM narrow 1 kHz, 100 Hz AM wide 5, 10, 12.5, 25 kHz SSB 1 kHz, 100 Hz
Frequency display	numeric, 100 Hz resolution
Memories	100, for frequency and mode
Audio power	1 watt into 8 ohms
Dimensions	18 × 8 × 22 WHD in cm
Weight	2.2 kg (4.85 lbs)
Power required	12 to 14 VDC at 500 mA
Accessories	telescope antenna, manual, fused DC cable mobile mounting bracket, extra large feet
Options	auxiliary TV board, external speaker, power supply, CAT interface
Price	List: US$679.95

AM wide	5, 10, 12.5, 25 kHz	wide (6 kHz)
AM narrow	1 kHz, 100 Hz	narrow (2.4 kHz)
USB/LSB	1 kHz, 100 Hz	narrow (2.4 kHz)

all filter values are at +/−6 dB

The receiver uses a triple superhet configuration for FM narrow, AM, and SSB. This is changed to double superhet for FM wide. A special option makes the reception of NTSC TV signals (sound and picture) possible; in this case the FRG-9600 operates as a single superhet.

The FRG-9600 comes with 100 memories for frequency and mode of operation, arranged in blocks of 10 each. This is a built-in feature, not an option. A special lithium battery provides back-up power for this memory. The lifespan of this space age marvel is about seven! years.

An external source of between 12 and 15 VDC at approx. 500 mA is required to operate this receiver. In some countries, a wall plug adaptor is supplied at no extra cost. Any device capable of supplying the required current at about 12 VDC will do nicely. Make sure you have checked the polarity of the plug before you get busy with this set: Center pin is positive!

Another point worth mentioning: This receiver needs 100 mA of current even when it is set to "OFF."

Read your manual

Some of the set's features are not evident even after a close study of the front panel. In recent years I've noted quite often, that a diligent study of the provided manuals is imperative to understand and use all functions of a particular receiver. The microprocessor controlled operation has all but eliminated the multitude of clearly labelled buttons and knobs which were the trademark of older sophisticated receivers. So, – read your manual. The same button may hide several functions, depending on the mode in use.

The desired frequency can be set (or arrived at) via numerous ways:

- direct keyboard input (leading zeroes required)
- memory recall
- continuous step tuning with large rotary control
- single step tuning with the adjacent pushbuttons UP/DOWN
- scanning (programmable for any frequency segment)
- selective memory scan
- priority scan

The scanning function offers some further refinements: There is a clever circuit which discriminates between noise and modulation. When set accordingly, the scan will stop only on channels which carry information, e.g. voice modulation. In addition, an adjustable squelch is provided.

The scanning function will repeat endlessly either on the programmed memory channels/banks, or within the owner-programmable frequency segment. It will halt when the channel is in use, or the signal content (including noise) overcomes the squelch threshold. After approx. five seconds, the scan resumes. The frequency display flashes the numbers sequentially to indicate a halt. If you want to stay on a particular channel, hit any of the UP/DOWN buttons momentarily. These buttons are also used to initiate a scan by pressing and holding either of them for about three seconds. The audio-selective scan is quite useful, because many services leave their carrier on constantly to "protect" a particular channel.

Normal squelch circuits would stop on these "busy" channels. The contents of the memory can be checked with either the manual tuning knob or the UP/DOWN buttons when the set is placed into memory mode. Any frequency may be transferred to memory by pushing D→M (dial to memory) and assigning a memory number.

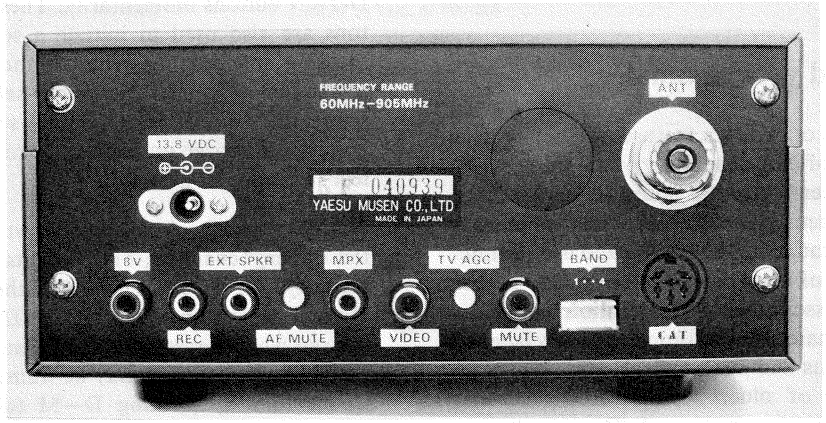
Vice versa, a memory channel can be used as a starting point for manual tuning (VFO) with M→D (memory to dial).

MR, of course, is Memory Read, and DIAL is sort of an escape function,—it transfers control back to the manual tuning mode.

STEP changes the tuning steps in sequence, i.e. the desired step size can only be reached by pressing this button repeatedly and watching the very small indicators to the right of the frequency display. Likewise, the mode must be changed this way with the button marked MODE, cycling from USB to LSB to AM wide to AM narrow to FM wide to FM narrow and back again to USB. The modes are indicated above the frequency display. Not enough, the blue-green indicator tube has a bargraph S-meter, a busy indicator, and memory channel readouts. Furthermore, the programmable clock and timer function are displayed. There is a timer controlled, relay-switched connection on the back, which may be used to activate the receiver together with a recording device. Another means to provide recording control is via the squelch-activated logic signal BUSY. This BUSY signal and the following inputs/outputs are available on the rear:

- antenna connector; UHF type, input for all ranges
- external speaker; 3.5 mm minijack
- DC in; low voltage power supply jack, input 12–15 VDC
- DC 8V; cinch, delivers 8 VDC at 200 mA max.
- Rec out; 3.5 mm minijack, recording output
- MPX out; 3.5 mm minijack, output for stereo decoder
- Video out; cinch, output of video when converter is used
- Mute; cinch, mutes receiver output when grounded
- CAT; special DIN, for computer controlled operation
- Band; Amperex, binary output of band information

Two potentiometers are accessible: one for TV AGC level and the other for interstation muting when receiving FM broadcasts. The CAT-connector, of course, can be used to interface this receiver with a suitably programmed personal computer. With this extension, most of the receiver's functions are accessible and it is relatively easy to make complete surveys of certain frequency bands, get a printout of channels used, and/or record voice traffic on busy channels. Yaesu offers two interfaces: a general purpose RS-232C unit and a special circuit board for the Apple II series of computers.



There also are some "black boxes" available to convert all or most of the frequency range from .1 MHz to 60 MHz to a signal which can be received by the FRG-9600. These converters are available from most large dealers selling specialized shortwave and scanner equipment.

The socket labelled BAND carries a binary word indicative of the frequency range in use. This output could be converted to an antenna switching signal. The immense frequency range can not be covered successfully by a single antenna.

The FRG-9600 comes complete with a multi-purpose mounting bracket for mobile operation. Also included are a DC cable with in-line fuse, a short telescope, and extra large plastic feet. Several options are available from Yaesu:

- a wall-plug adaptor for home use
- a TV board (NTSC only)
- an external speaker

I've already mentioned the interfaces to a home computer. Some dealers may also sell or provide suitable software.

Solid, sensitive, and versatile

The multitude of built-in features is simply astounding. Of course, the operator must know what he wants and what he does. Simply turning the large and very strongly detented tuning knob while waiting for stations to pop up can become a frustrating experience. The vast frequency range covered by this set is sparsely populated when compared to shortwave bands. If you tune too fast you'll just miss the important stations. It is much better to let the receiver do the job with the audio selective scanning feature provided. This, however, can take an enormous amount of time.

It is much easier to use one of the better (and up to date) scanner frequency listings and set the memories accordingly. A magazine like Popular Communications is also recommended, they have the latest updates and sometimes print comprehensive frequency tables for certain areas. Once frequencies (or bands) are known, this little radio will deliver an extraordinary melange of police, public service, emergency, commercial, military, airport and ham traffic.

Most other scanners (there are a few exceptions) are not able to receive above 512 MHz. So here is a short summary of what can be picked up in this top band:

- UHF television channels
- land mobile radio
- cellular radio, mobile
- cellular radio, base stations
- short range personal intercoms (military/commercial)

The FRG-9600 has excellent sensitivity throughout the entire frequency range. During the flight of the D-1 mission with the NASA space shuttle (November 1985), I was able to catch direct traffic on 2 meters with a simple 4-element antenna. The high sensitivity comes at a price. There is some IF breakthrough which can be annoying, especially in the 2 meter ham band. A resistive attenuator (approx. 20 dB) can be used to combat this and other types of interference. Circuit noise of FM narrow seems to be somewhat high. I simply couldn't get better S/N ratios than 40 dB in this mode. FM wide is fine, here values of about 55 dB were obtained. This is not exactly a high fidelity signal, so don't overrate the MPX output. The built-in speaker radiates upward. Overall, sound reproduction is allright. For mobile operation a larger speaker (and more audio power) are needed.

This scanner is almost ideally suited to dissecting the complex signals of mobile radiotelephone band segments. The novel S-meter is calibrated accurately, with the display portion changing from blue to red above S = 9. The entire display is very easy

to read, it has excellent contrast and extremely crisp symbols. If used in a motor vehicle, make sure you put this set close enough for comfortable reading of the indications. The display area is small and it can be utterly distracting (and dangerous) when one has to look again and again to read e.g. the frequency.

All in all, this is a beautiful piece of equipment and one of the finest scanners available. The FRG-9600 costs about US$ 600.–. It is well worth this price.

Note

There is, of course, a small but important difference between scanning and searching. Scanning refers to a sequential automatic (or manual) tuning of preprogrammed channels or frequencies, whereas searching is a continuous tuning process through an entire frequency range. But, virtually nobody makes this distinction anymore,–so scanning it is when a receiver tunes automatically.